AUGUST • 1956

NLGI Spokesman

Journal of National Lubricating Grease Institute

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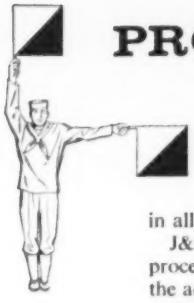

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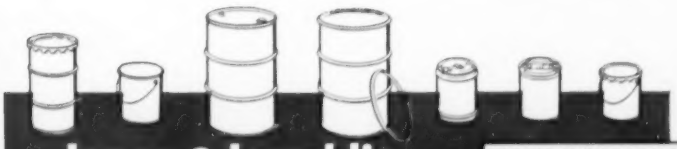

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President's page

by W. M. MURRAY, President, NLGI

SUMMER PASTORAL

Some Thoughts About the Summer Scene

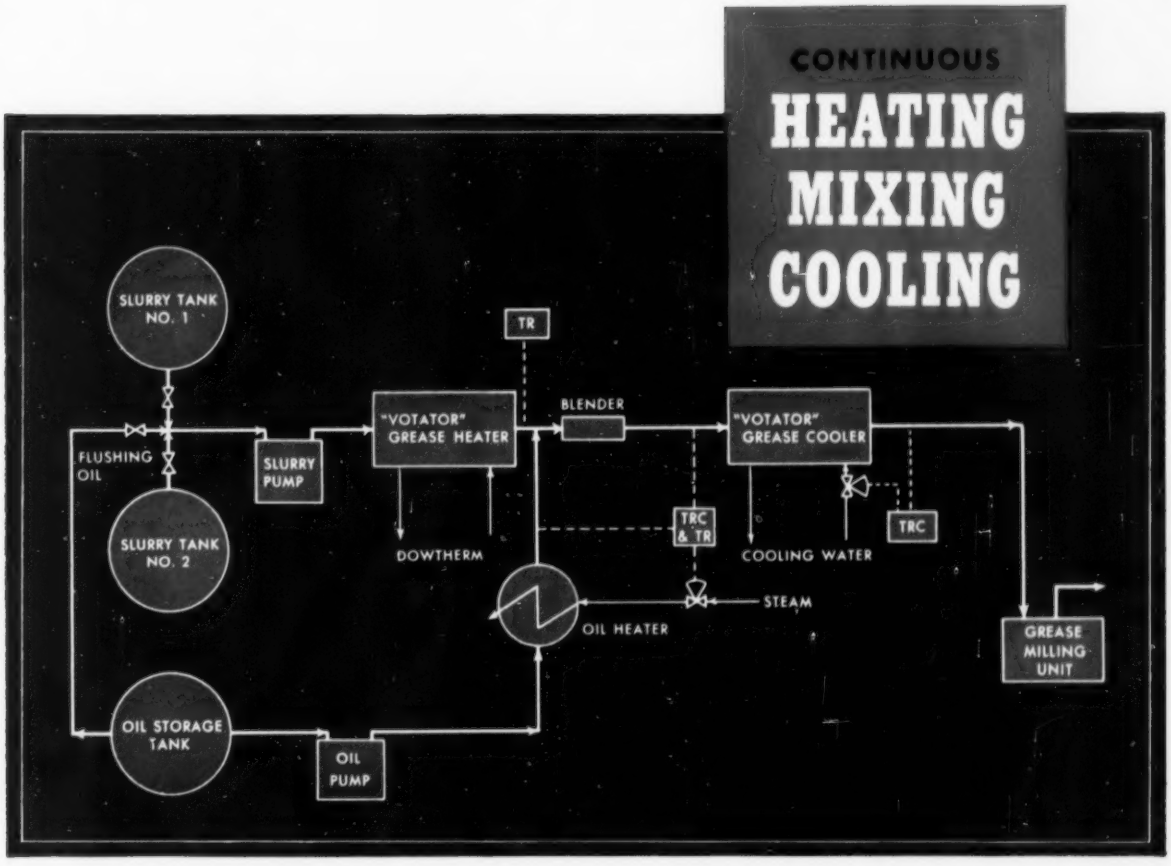
A feature writer for a prominent news publication made recent reference to "the recession of 1954." Imagine that! I thought that we were then enjoying a return to "normalcy." The economic significance of the slow-down has been lost in the fine progress that later developed. Within a year and one-half of December '54, industry sponsored employment was up to an all-time record, one which, if maintained, will result in a period of greatest productivity.

Sizeable work stoppages, due to labor disputes and other causes, evidence the fact that all employed manpower is not always productive. Vacations cut down mid-summer production of goods without changing maximum employment figures. To borrow from Deep Rock slogans, a vacation may well be "The Stop that Keeps You Going." Thus, work stoppages involving vacations are consistent with good business practices.

If you haven't taken recreational time off lately, may I suggest that you brush up on that adage about "all work and no play," and then that you do something about it.

I am going to sample this advice and temporarily become a non-productive but fully paid employee so that I too may enjoy the compelling beauties of nature. Davy and Tommy (young grandsons) have agreed to make up the balance of the trio for what will be their first fishing trip. So, instead of concentrating further on this message, I am going to conserve reasoning to spend on the where and the how that will make the vacation turn out successfully. Looks like I have new responsibilities.

So long, and good bargaining on the first tee!



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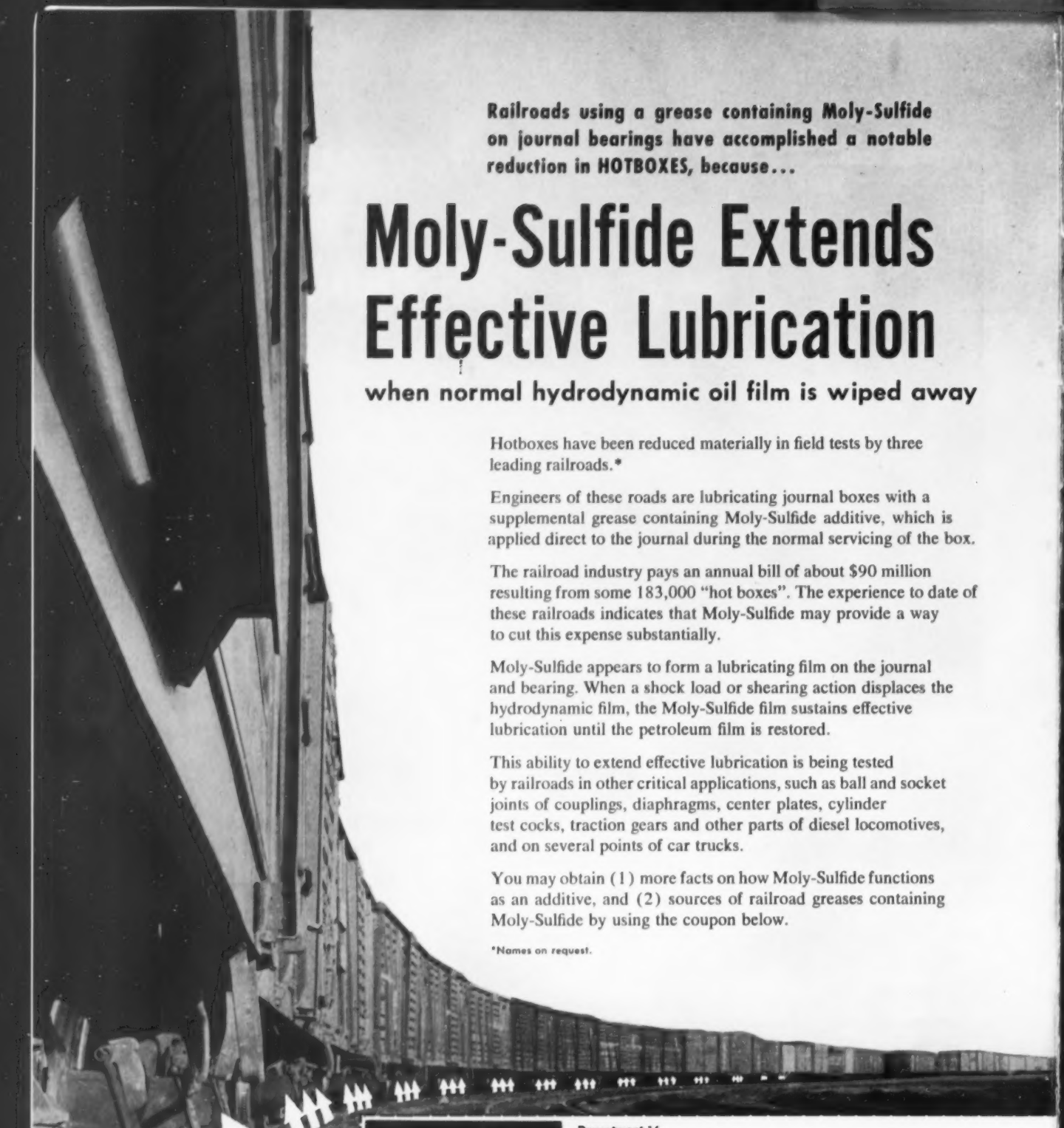

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ABOUT THE COVER

Is the modern service station becoming obsolete? As automation steadily invades industry, this is one prominent question concerning lubricating grease. Raymond Shaw, president of Chek-Chart Corporation, answers with elan and the authority of many years' experience in his article "The Service Station and Automotive Service . . . WHAT HAPPENS TOMORROW?" See page 23.

STAYS

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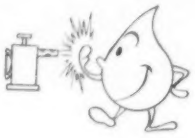
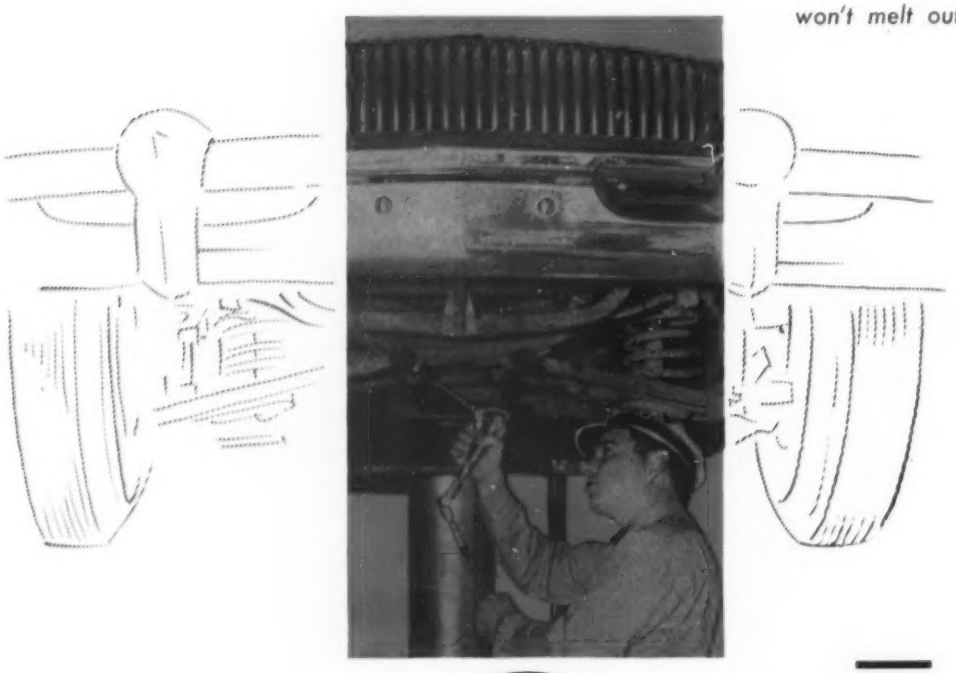


won't melt out



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INLUCITE 21

LOW Temperature Operation of Aircraft Accessories

By E. A. BANIAK and R. S. BARNETT
The Texas Company, Beacon, N. Y.

ABSTRACT

IN ORDER TO investigate the performance of greases at low temperatures in actual aircraft accessory equipment, a project was set up which included the testing of five greases in five types of accessory equipment.

It was desired to ascertain whether there were more variations in the performance of similar accessory units than there were variations attributable to the performance of similar greases, and whether the power available in the units was sufficient to overcome the low temperature resistance offered by the lubricants. It was also desired to establish the correlation, if any, between the low temperature properties of the greases evaluated as required by MIL Specifications in terms of a selected torque of 2000 gram-centimeters in a No. 204 ball bearing and the corresponding data obtained on the accessories using smaller bearings with accompanying gear-box and screw-feed mechanisms.

Tests on each of the greases were conducted at room temperature, −65 and −100°F. Of the five greases tested, Greases A, B, and C were MIL-G-3278 Specification greases, Grease D was an MIL-G-7421A Specification grease and Grease E was a high temperature grease (with fair, low temperature properties) which does not meet any military specification.

The following conclusions were drawn on the basis of the results of this investigation, including a statistical analysis of the data.

1. Power requirements of accessories are overriding factors in performance, minimizing small differences in grease torques which may be detected with sensitive laboratory apparatus.

2. There was as much variation in the low temperature power requirements of the accessory units of the same design as there were variations attributable to the performance of similar greases.

3. When lubricated with MIL-G-3278 or MIL-G-7421A Specification greases, the power available was sufficient for operating to −100°F. in all integrally motorized equipment except for the antenna assembly.

4. There was no definite correlation between the results of the low temperature torque tests (carried out in No. 204 ball bearings) and the results of the tests on actual aircraft accessory equipment.

5. Grease D was superior to all other greases in low temperature performance.

6. Greases A and B were approximately equivalent and slightly superior to Grease C.

7. Grease C was definitely superior to Grease E.

Introduction

The main objective of the work was to determine the low temperature operational characteristics of various lubricants in aircraft accessory assemblies, these assemblies being furnished by the U.S. Air Force in accordance with the terms of the contract covering this work. It was necessary to fabricate suitable test stands and assemble proper sources of electrical power for each of the accessory assemblies.

Another objective of the work was to determine the variations in the low temperature power requirements of accessory units of the same design and to compare these findings with the performance of similar greases (such as those meeting the same military specification) in these pieces of equipment. It was also desired to ascertain whether the power available to each accessory was sufficient to operate the mechanism at various low temperatures using the selected lubricants.

A final objective was to determine the correlation, if any, between the low temperature properties of greases, evaluated as required by military specifications in terms of a selected torque of 2000 gram-centimeters in a No. 204 ball bearing, and the data obtained on the accessories which use smaller ball bearings together with accompanying gear box and/or screw-feed mechanisms.

Scope

The investigations reported herein were carried out over a period of two years ending September 1, 1953. Data were obtained on the five lubricants[1] described below:

Lubricant		*Meets Specification*	*Nominal Temperature Range, °F.*[2]
Grease A	Li Soap/Synthetic Oily Component	MIL-G-3278	−65 to 250
Grease B	Li Soap/Synthetic Oily Component	MIL-G-3278	−65 to 250
Grease C	Li Soap/Synthetic Oily Component	MIL-G-3278	−65 to 250
Grease D	Li Soap/Synthetic Oily Component	MIL-G-7421A	−100 to 225
Grease E	Na Soap/Synthetic Oily Component for High and Low Temperature Operation	None	−40 to 300

1. Physical and chemical tests of the lubricants are given in Table X. These data include apparent viscosity determination at −65°F.

2. The low temperature shown is that at which grease allows one revolution of a No. 204 test bearing at 2000 gm-cm torque in 5 seconds or less.

The lubricants described on page 1 are all capable of continuous operation at elevated temperatures of 225 to 300° F., depending upon their classification. However, only temperatures of controlled room ambient to −100°F. were studied in the present work.

The pieces of apparatus used in conducting this test work were:

1. Laboratory Torque Test Equipment
   a. Vertical Spindle, MIL-G-3278 Low Temperature Torque Test
   b. Starting and Running Torque Apparatus (ASTM-type)
2. Equipment tested under Contract AF-33(038)-15495 was as follows:

Item No.	*Item*	*No. Units Tested*
1	Landing Light Assembly, Retractable	2
2	Actuator Assembly, Shutter-Vane Intercooler	3
3	Actuator Assembly, Bomb Bay Door	2
4	Gear Assembly, Elevator Flap Tab	2
5	Antenna Assembly	2
6	Inverter Assembly, Rotary Type D-1, 28 Volt DC to 115 Volt AC, Single Phase, 400 Cycle. (Power source)	1

The pieces of equipment listed above are described separately under the appropriate sections in the body of this paper. Five accessories were tested for low temperature operation.

EXPERIMENTAL WORK

I. LOW TEMPERATURE TORQUE TESTS

A. Apparatus

The apparatus used in conducting the low temperature torque tests consisted of an insulated cold chamber with an air-circulating motor, drive motor and gear reduction box, strain arm and strain-recording gage. A suitable spindle utilizing a No. 204 bearing, and based on the proposed ASTM design, was used for the starting and running torque tests. This spindle, after assembly, was placed in the cold chamber in a horizontal position and coupled to the gear reduction shaft. A different MIL-G-3278 type spindle was used with a No. 204 ball bearing for making torque tests by both the MIL-G-3278 and the Gus Kaufman* methods. This spindle, after assembly, was placed in the cold chamber in a vertical position.

B. Procedure

Three grams of the test grease were packed into an eight-ball type, 204-K ball bearing. The grease was distributed to both sides of the bearing with no grease extending beyond the face of the race. The bearing was then rotated 100 revolutions in each direction between 100 and 200 rpm.

*A Texas Company Method.

1. For the MIL-G-3278 method, the cold box was brought down to −65°F. in approximately 1½ hours and held at that temperature for two hours. During the cooling and soaking period the spindle was rotated one revolution in each direction every 15 minutes. At the end of the soaking period the 2000 gram-centimeter torque was applied and the time for one complete revolution of the bearing in a clockwise direction was recorded. After 15 minutes the load was again applied and the time for one complete revolution in a counterclockwise direction was recorded.

2. For the Gus Kaufman method, the same spindle with the same load as described in paragraph 1 was used. However, the test was started at a temperature of 20°F. and lowered in five degree increments until a reading of more than 30 seconds per revolution was obtained. This gives a rating in terms of temperature to the nearest 5°F. increment.

3. For the proposed ASTM Low Temperature Starting and Running Torque Test method, the cold box was brought down to −65°F. in approximately 1½ hours and held at that temperature for two hours. The shaft on which the bearing was mounted was then rotated at one rpm for 25 minutes by the drive motor through the speed reducer. Both the starting and running torque requirements were recorded on the strain gage chart.

C. Data and Results

The data obtained for the five greases using the MIL-G-3278 method are shown in Table I, below. As was expected, Grease D was rated best and Greases A, B, and C were about equivalent while Grease E was rated poorest. Greases A, B, and C were considered equivalent primarily because Specification MIL-G-3278 requires that a grease make one revolution in five seconds or less to be satisfactory. On this basis, Greases A, B, and C all were satisfactory.

TABLE I

Low Temperature Torque Tests, MIL-G-3278 Method

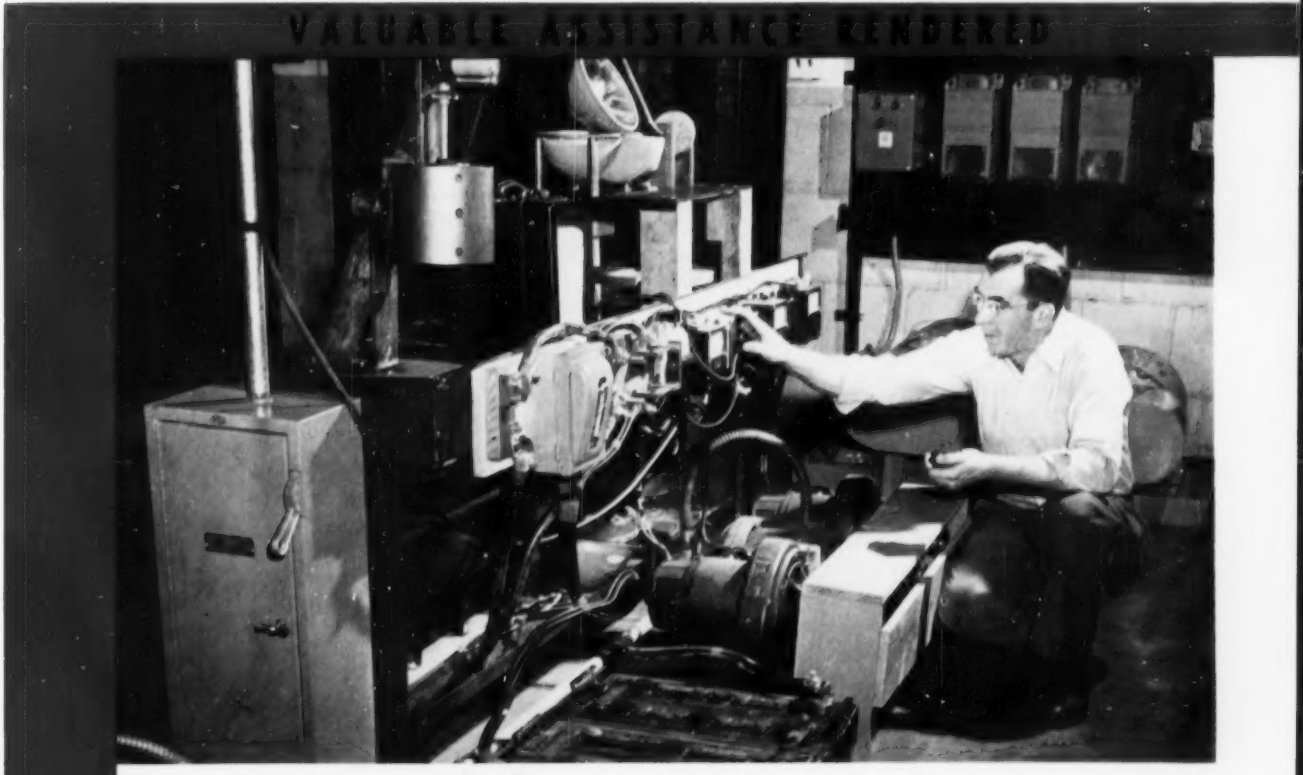
Vertical Spindle, −65°F., 2000 Gram-Centimeters Torque

Grease	*Time, seconds for one revolution*	
	Clockwise	*Counterclockwise*
A	2.6	2.4
B	1.2	1.0
C	2.4	2.0
D	Too fast	Too fast
E	Too stiff*	Too stiff*

*Bearing required more than a minute in making one-half of a revolution.

As the five greases under investigation are of three different types, that is, one extremely low temperature grease (Grease D), three MIL-G-3278 aircraft instrument greases for low and high temperature operation (Greases A, B, and C) and one extended temperature range grease (Grease E); it was decided to evaluate them by the Gus Kaufman method to give a more specific indication of the low temperature torque characteristics. The data obtained using this procedure are shown in Table II. It was obvious that Grease D again was superior to all the other

VALUABLE ASSISTANCE RENDERED



HIS AID to the authors was particularly valuable . . . technician John Kormondy, shown here operating associated electrical equipment device in connection with the retractable landing light assembly test, carried out much of the test work shown on the units. Note the shutter-vane intercooler actuator assembly, shown at the left of the picture.

greases, as it was still satisfactory down to −105°F. which was the minimum temperature obtainable with the apparatus. Grease A, B, and C were approximately equivalent, with Greases A and C failing at −95°F. and Grease B failing at −90°F. Grease E was inferior to the other greases in that it failed at −60°F. The "failing temperatures" cited above are defined as those at which the greases required more than 30 seconds for one revolution of the bearing. In each case the "satisfactory temperature," (the lowest temperature at which the grease allowed one revolution with 30 seconds), was five degrees above the failing temperature.

TABLE II

Low Temperature Torque Tests, Gus Kaufman Method

Vertical Spindle, 2000 Gram-Centimeters Torque

Grease	*Failing Temperature, °F.*
A	−95
B	−90
C	−95
D	lower than −105
E	−60

The Starting and Running Torque determinations on these greases are shown in Table III, page 12. Five runs were made on each grease and it can be readily seen that the values vary considerably. Using the average value of starting torque for the five runs, Greases C and D are approximately equivalent and best. Grease B rated second and Grease A was third. Grease E was poorest, rating fourth. On the basis of average running torque, Grease D was suprior to all others. Greases A, B, and C were approximately equivalent and second best. Grease E was rated poorest.

It is of interest that the Starting and Running Torque values are generally in line with the −65°F. apparent viscosities of the five greases. See Table X. The apparent viscosities, however, do not correlate with either the MIL-G-3278 torque test (Table I) or the Gus Kaufman Torque Test (Table II) in that Greases A, B, and C are substantially equivalent in these two latter torque tests; whereas, the apparent viscosities and the Starting Torque values indicate Grease A to be stiffer than Grease B and C meeting the same specification.

TABLE III

Low Temperature Starting and Running Torque, Proposed ASTM Method

−65°F., 1 RPM 13 CM Diameter Housing, 3 Grams Grease Charge

Grease	*Run 1*	*Run 2*	*Run 3*	*Run 4*	*Run 5*	*Average*
STARTING TORQUE, GM-CM						
A	728	1077	1040	1170	845	972
B	982	527	605	760	865	748
C	520	325	598	358	702	501
D	400	370	572	501	358	440
E	3575	4783	4128	2990	2990	3693
RUNNING TORQUE, GM-CM						
A	65	85	117	130	110	101
B	98	52	98	110	110	94
C	98	52	98	117	176	108
D	40	39	46	110	98	67
E	163	65	325	260	358	234

It may be generally stated, based on these low temperature torque tests, that:

1. Grease D was superior to all other greases tested.
2. Greases A, B, and C were generally equivalent and next best.
3. Grease E was inferior to all other greases tested.

II. TESTS ON AIRCRAFT ACCESSORIES

The accessories described in the Scope were lubricated and operated according to the pertinent AN Specification, handbook and/or Technical Order. Wherever sealed, prelubricated antifriction bearings were present, these were removed and sent to the bearing manufacturer for relubrication with the five greases being tested. This insured that each accessory and unit thereof was completely lubricated with the particular test grease under study.

The units were soaked at the test temperature for 24 hours and each unit was operated at least twice at the test temperature. Weighed amounts of grease were charged to the units so that each unit of a particular mechanism contained the same quantity of test grease at each lubrication point. Where the pertinent instruction did not specify the exact quantity of grease to be charged to a bearing, an amount equivalent to 50% of the voids was used in accordance with accepted field practice.

The data taken in this study have been statistically treated. Analyses of the variances found were made, using the "f" test (1),* mean-over-range test (2), and students' "t" test (3). The conclusions given in the present paper are confirmed by the statistical study; however, this treatment is omitted in the presentation to follow, both to save time and publication space, and because some of the statistical differences found were too small to be of practical significance in terms of equipment performance.

Considerable data on power requirements were taken during this study. However, these have been eliminated

*Numbers in parenthesis refer to references cited in Bibliography.

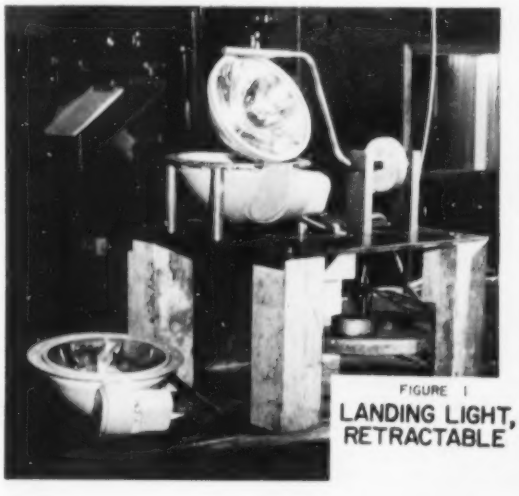


FIGURE 1
LANDING LIGHT, RETRACTABLE

from the present paper to conserve space, and because the over-all conclusions are well supported by the "time for operation" data at various low temperatures included herein. The scope of the power determinations has been given for each accessory for general information.

Retractable Landing Light Assembly

A. Apparatus

Figure 1 portrays this item of equipment. Two of these units were tested and are shown in the photograph; one is shown mounted for operation in the test stand. The equipment also included a loading device and a DC recording ammeter. The Light Assembly consisted of a 28-volt DC motor and gear box, a stationary housing and the lens which contacted the lever arm of the loading device.

An open circuit voltage of 28.5 and a closed circuit voltage of 28 were maintained on the motor circuit of the light under test.

Service conditions were simulated in that a test device was used to apply a uniform counter pressure of 15 pounds throughout the travel of the lamp (from the flush position to the extended position only; when the lamp was retracted, the 15-pound pressure assisted the motor). The 15-pound pressure was applied perpendicular to the plane of the lamp lens and on the outer edge of the lamp retaining ring at the point opposite the hinge of the movable housing.

B. Procedure

Prior to testing, the landing light was disassembled, cleaned in Stoddard Solvent, and thoroughly dried. Two grams of the lubricant to be tested were buttered on all gears of the landing light assembly. The unit was reassembled and mounted in the test rig so that the simulated service load could be applied to the landing light.

The equipment was tested* at −65 and −100°F. After soaking in a cold box for 24 hours at the test temperature, testing was conducted by operating the unit so that it was made to extend and retract twice. Because the landing lights work against the 15 pounds simulated service load only during the extension phases of their operation, only the data obtained during extension have been summarized for this report.

*Room temperature data are omitted from this paper unless needed to exemplify performance of accessories which did not operate satisfactorily at low temperature.

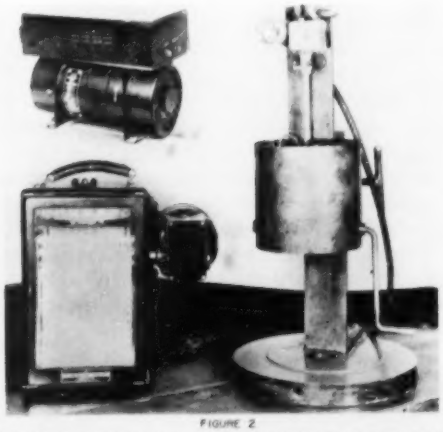


FIGURE 2
ACTUATOR ASSEMBLY SHUTTER-VANE INTERCOOLER

C. Data and Results

Table IV presents the average seconds for full extension of the landing light units against 15 pound loads. It may be seen that all five greases gave equivalent performance, working essentially as well at −100°F. as at −65°F. This, of course, shows that this assembly possesses an excess of power in that Grease E, a "−40 to 300°F." product, worked as well as Grease D, which is designed for −100°F. to 225°F. operation.

TABLE IV

Landing Light Assembly, Retractable

Average Seconds for Full Extension Against 15 Pounds Load

		Unit No. 1		*Unit No. 2*	
Grease	*MIL-G*	*−65°F.*	*−100°F.*	*−65°F.*	*−100°F.*
A	3278	9.7	11.2	10.8	12.8
B	3278	10.2	10.7	9.7	11.1
C	3278	10.5	11.4	9.4	11.5
D	7421A	10.3	10.5	10.1	11.2
E	None	10.5	11.3	10.7	11.5

Maximum seconds at −67°F. = 17

Actuator Assembly, Shutter-Vane Intercooler

A. Apparatus

The subject accessory is shown in Figure 2. This photograph shows the actuator mounted in the test stand in position to operate under a tension load. The actuator was fastened to the upper part of the test stand by means of a pin through the mounting eye on the actuator housing. The 35-pound dead weight (concealed in the metal cylinder which guided the weight) was fastened with another pin to the mounting eye at the end of the nut tube. The upper portion of the test stand could be rotated in a vertical plane at any angle with respect to the lower part of the test stand and was held in place by a lock screw. The crank mounted near the bottom of the guide cylinder was fitted with an eccentric which was used in removing the weight from the actuator. The wattmeter was used for measuring the power requirements of the actuator motor.

The power for the actuator motors was obtained from a single phase, 115-volt, 400-cycle inverter furnished by the Air Force.

B. Procedure

Prior to testing, the actuator assembly was disassembled, cleaned with Stoddard Solvent, and thoroughly dried. The two reduction gear bearings, the housing bearing and the cap bearing were removed and replaced with similar bearings prelubricated with the tes grease. The jack screw, worm and drive gear, and reduction gears were lubricated with two grams of the same test grease.

After reassembly, the units were tested at −65°F. and −100°F. Subsequent to soaking in a cold box for 24 hours at the test temperature, the actuator was operated to ex-

tend fully and retract twice at no-load and twice against the dead weight load of 35 pounds, as required by the pertinent Technical Order. In making the tensional load (retraction of the screw) tests, the actuator was mounted so as to lift the dead weight vertically upwards. In making the compression load (extension of the screw) tests, the upper part of the test stand was rotated 180 degrees in a vertical plane and locked in place, and the actuator was operated so that it pushed the dead weight vertically upwards.

C. Data and Results

Table V gives the average seconds for full extension against the 35-pound compression load. It may be seen that all the greases are practically equivalent at −65°F. but that Grease E is frozen at −100°F. There is substantially no difference between the results obtained for the three units of this accessory. (Data for retraction times against the tensional load, being similar to the extension data, are excluded from this paper.)

TABLE V

Actuator Assembly, Shutter-Vane Intercooler

Average Seconds for Full Extension Against 35 Pounds Compression Load

		Unit No. 1		*Unit No. 2*		*Unit No. 3*	
Grease	*MIL-G*	*−65°F.*	*−100°F.*	*−65°F.*	*−100°F.*	*−65°F.*	*−100°F.*
A	3278	14.8	14.8	15.5	15.9	14.9	14.9
B	3278	14.7	15.0	15.3	15.4	14.4	14.9
C	3278	14.8	14.6	15.1	15.6	14.5	14.4
D	7421A	15.4	15.5	16.1	15.9	15.1	14.8
E	None	15.7	Frozen	16.2	Frozen	15.5	Frozen

Seconds for full stroke at rated load = 15 to 20

Actuator Assembly, Bomb Bay Door

A. Apparatus

The subject assembly is shown in Figure 3. These assemblies were operated in accordance with the pertinent handbook of overhaul instructions which states that the gear ratio between the motor and cable drum is 506 to 1. At no load the motor speed is 12,000 rpm, which gives a cable drum speed of approximately 23.7 rpm. At rated loads the cable drum speed should be 20 rpm. The motor is rated for intermittent duty, one minute on and twenty minutes off.

Performance tests specified for this actuator require the use of a prony brake to obtain power current and RPM values for different applied torques. However, for the purpose of evaluating the lubricant, a simpler test stand was constructed. This was also compact enough to fit into the available cold box. This stand allowed application of load by means of a dead weight suspended by a ⅛-inch diameter nylon cord wrapped around the cable drum. Timing the vertical travel of the weight through a given distance (22.4 inches) was used as a criterion of performance. (Two complete revolutions of the cable drum corresponded to a vertical travel of 22.4 inches for the weight.) A 25-pound weight was used which gave a torque of approximately 45 inch-pounds.*

A motor-generator set, which supplied 400 cycle, 200 volt, 3-phase AC power was set up to provide the power for the actuator motors. The generator was provided with a field rheostat so the voltage could be adjusted to exactly 200. Included in the circuit were a triple-pole double throw switch for reversing the direction of rotation of the actuator motor, a voltmeter to insure that the voltage was maintained at 200, and a recording AC wattmeter for determining the instantaneous starting power and average running power requirements of the actuator motors.

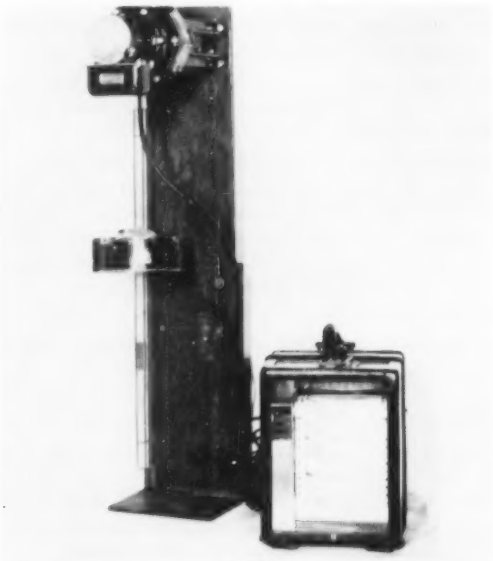


FIGURE 3

ACTUATOR ASSEMBLY, BOMB BAY DOOR

B. Procedure

Prior to testing, the actuator assembly was disassembled, cleaned with Stoddard Solvent, and thoroughly dried. A ten-gram sample of the test grease, an amount found to be adequate for this unit except for the seven ball bearings, was weighed out for lubricating the actuator. From this ten gram sample, the two needle bearings which support the cable drum shaft and the needle bearing which supports one end of the sun gear shaft were packed approximately 50 per cent full. The remainder of the grease (about 7½ grams) was buttered onto the tooth surfaces of the gears. The seven ball bearings which support the shafts of the various reduction gears in the assembly were removed and replaced with similar ball bearings prelubricated with the test grease. The actuator unit was then reassembled and mounted on the test stand so that the load could be applied for testing.

The units were tested at temperatures of −65° and −100°F. After soaking at the test temperature for 24 hours, the actuator assembly was operated and the fol-

*Cable drum radius = 1.8 inches.

lowing data were obtained: the time for two complete revolutions of the cable drum (equivalent to 22.4 inches vertical travel of the dead weight), the maximum starting power and the average running power for the actuator motor.

C. Data and Results

Results of the tests conducted on the two Bomb Bay Door Actuator Assemblies are listed on Table VI.

It will be observed from Table VI that Grease D was slightly better at −65°F. than the other greases. Unit No. 1 refused to operate at −100°F. on Grease E, whereas Unit 2 gave satisfactory operation at this temperature on Grease E.

TABLE VI

Actuator Assembly, Bomb Bay Door

Average Seconds for Two Cable Drum Revolutions

(22.4-inch vertical movement of applied load of 25 pounds)

Greases	*MIL-G*	*Unit No. 1*		*Unit No. 2*	
		−65°F.	*−100°F.*	*−65°F.*	*−100°F.*
A	3278	5.1	5.2	5.0	5.1
B	3278	5.3	5.1	5.2	5.2
C	3278	5.0	5.0	5.3	5.1
D	7421A	4.9	5.0	4.9	5.0
E	None	5.2	Frozen	5.3	5.5

Note: Average seconds at 77°F. ranged from 4.8 to 5.1

Elevator Flap Tab Gear Assembly

A. Apparatus

The subject apparatus which is a component of a more extensive system, is shown in Figure 4. According to operating instructions, the flap-operated tab cables which pass over a pulley mounted on the work shaft are tightened until there is a tensional load of 40 ± 10 pounds in the cables. The speed at which the gear assembly is driven was not stated; however, it was noted that it required 172 revolutions of the worm shaft for full 35-degree elevation of the tab. Assuming that it would require five to ten seconds to get full elevation the worm shaft would be required to rotate between 2064 and 1032 rpm. It was therefore decided to power the laboratory set-up with a 1725 rpm motor (⅛ HP), since most fractional horsepower commercial motors run at that speed.

The test stand with the gear assembly and loading device was located inside a cold box while the drive motor was located outside the cold box, using a floating drive shaft approximately 12 inches long. This shaft was fitted with universal couplings on both ends to correct any misalignment between the motor and gear assembly.

To facilitate the application of the load, the gear assembly was inverted when mounted on the test stand (worm gear shaft above the worm shaft). Mounted thus, the load could be applied in proper direction by hanging a weight vertically from an idler pulley which transmitted the load through an endless cable (⅛-inch nylon) to the pulley on the work gear shaft. The load was a 72-pound lead weight which placed the cable on each side of the pulley under a 36-pound tension.

B. Procedure

Prior to testing, the gear assembly was disassembled, cleaned with Stoddard Solvent, and thoroughly dried. Using a 100-gram quantity of grease, the bearings were packed full and the worm and reduction gear teeth were hand lubricated. The grease remaining from the original 100 grams was packed into the gear housing. Although the units as received were packed full (220 grams of grease), only approximately 50 per cent (100 grams) of a full pack was used, because accessories tested previously were similarly packed, and also to conform to good field practice.

The apparatus was assembled, placed in a cold box brought to the test temperature and soaked at this temperature for 24 hours.

The units were tested at temperatures of +77° and −65°F. on all greases. Greases A and D were tested at −100°F., since they both operated at −65°F.

The following data were obtained:

1. The time for five complete revolutions of the work gear shaft (equivalent to 3.72 times the necessary travel for full elevation of tab) was found more convenient than to measure the travel for full elevation, which requires only 1.344 revolutions of the work gear shaft.

2. The maximum starting power and the average running power for ⅛-horsepower drive motor.

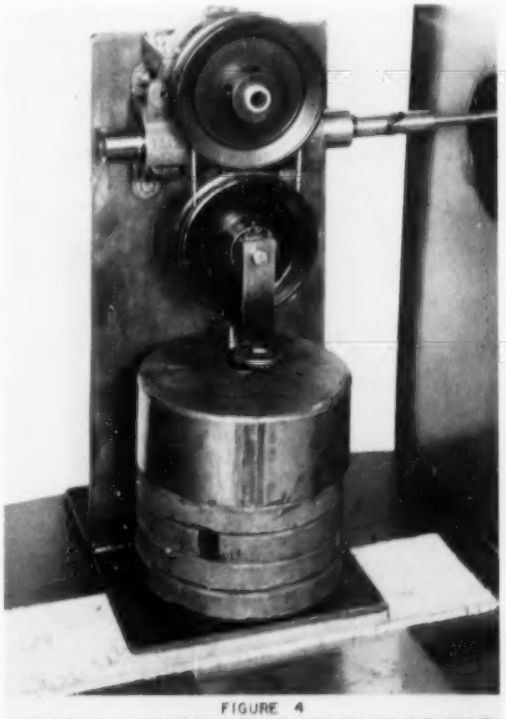


FIGURE 4

GEAR ASSEMBLY, ELEVATOR FLAP TAB

TABLE VII

Gear Assembly, Elevator Flap Tab

Average Seconds for Five Revolutions of the Work Shaft Under 36 Pounds Tension Load

Greases	*MIL-G*	*Unit No. 1*		*Unit No. 2*	
		77°F.	*−65°F.*	*77°F.*	*−65°F.*
A	3278	21.7	24.1	21.7	Stalled
B	3278	21.6	Stalled	21.5	Stalled
C	3278	21.6	Stalled	21.6	Stalled
D*	7421A	22.0	22.9	21.7	22.5
E	None	21.8	Frozen	21.7	Frozen

Full Flaps = 1.344 rev. of the Work Shaft

*Tested at −100°F., but would not run.

C. Data and Results

Table VII gives the average seconds for 5 revolutions of the work shaft under the 36-pound tension load. The two units of this accessory* could not consistently operate at −65°F. with any but Grease D meeting Specification MIL-G-7421A. Also, Unit 2 stalled with Grease A (MIL-G-3278); whereas, Unit 1 allowed satisfactory operation at −65°F. with this grease.

Grease E (−40 to 300°F. grease) required somewhat greater running power than the other four greases.

Antenna Assembly

A. Apparatus

The Antenna Assembly shown in Figure 5 is set up for bench testing. The azimuth-drive motor, which is geared to the large ring gear, provided the rotation of the antenna. The tilt motor, through a suitable gear reduction box and a crank arm mechanism connected to the tilt track, tilted the antenna. A DC recording ammeter was used to measure the amperage, and the voltage was measured by a DC voltmeter for both motors.

The power required to operate the 27.5 volt tilt and azimuth-drive motors was obtained from a 3400 rpm, 1500 watt, 30 volt DC generator. The voltage output of the generator was adjusted to 27.5 by means of a field rheostat.

B. Procedure

The antenna assembly was first disassembled, cleaned with Stoddard Solvent, and thoroughly dried. The tilt-motor gear box was packed from 10 grams of the test grease. In each instance the gears were individually lubricated by hand before being mounted on the gear shafts. After all gears were lubricated, the grease remaining from the original 10 grams was packed into the gear box assembly.

The azimuth-drive motor gear box was packed with 20 grams of the test grease. As with the tilt-motor gear box, the gears were individually lubricated, assembled, and the grease remaining packed into the gear box. Also,

*Powered with ⅛ HP motor. The fraction of power available for this gear box in aircraft service is not known, as it was part of a motor-driven system actuated through screws and torque tubes to convert torque-tube motion to cable motion. System performance was marginal at low temperatures.

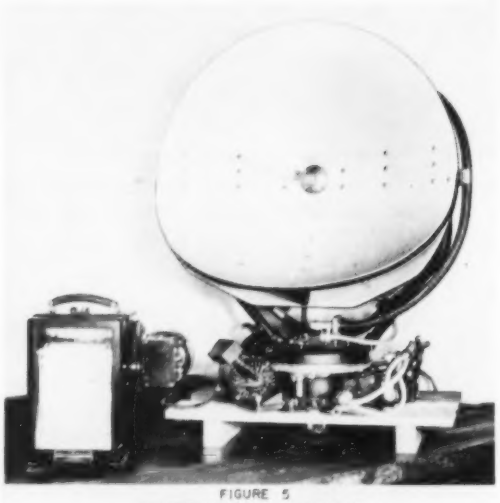


FIGURE 5

ANTENNA ASSEMBLY

TABLE VIII

Antenna Assembly (Rotation)

*Average Seconds for 10 Revolutions (No Added Load)**

Greases	*MIL-G*	*Unit No. 1*		*Unit No. 2*	
		77°F.	*−65°F.*	*77°F.*	*−65°F.*
A	3278	37.4	Stalled	30.7	Stalled
B	3278	35.6 (37.5)	Stalled (ck.)	30.5 (32.6)	48.3 (75.0)
C	3278	38.1	Stalled	31.6	Stalled
D	7421A	41.1 (35.8)	Stalled (ck.)	31.0 (32.2)	Stalled (63.9)
			0°F.		0°F.
E	None	39.7	73.9	31.2	37.1

Rotation at 13 to 21 RPM (46.1 to 28.6 seconds for 10 RPM) specified.

*Average of CW and CCW revolutions. ( ) = test repeated

a film of test grease was applied by hand to the tilt track, rotary base ring gear and azimuth-drive pinion gear. For both gear cases, the greater charge represented less than 50 per cent of a full pack, which is considered good field practice, as more grease would only increase friction and would not aid in lubrication.

Operating instructions specified that the antenna should tilt up to a maximum of about 10 degrees and down to about 30 degrees from horizontal, and rotate at 13 to 21 rpm.

The apparatus, after being assembled, was placed in a cold box, brought to the test temperature and soaked at this temperature for 24 hours. The units were tested at temperatures of +77° and −65° F. Greases A, B, and D were run at −100°F. on Unit No. 2, since the tilt motor operated at −65°F. with these greases. Grease D was also tested at −100°F. on Unit No. 1. Grease E, a high-low temperature grease, was run at 0° and −50°F.; however, it failed to allow operation at −50°F.

In view of the lack of reproducibility between the two units, check runs were made on Greases B and D, which gave the best performance on these units. These were made by relubricating each unit with the grease in ques-

tion and re-running at 77°F. and −65°F.

The following data were obtained: The time for ten complete revolutions of the antenna, the maximum starting power and the average running power for the 27.5 volt, shunt-wound, azimuth-drive motor. Also, the time required for the full upward tilt of the antenna and the average running power required for the 27.5 volt series tilt motor were recorded. For the tilt motor, the starting torque and the running torque were essentially equal; therefore, only the average power requirement data were recorded.

C. Data and Results

Table VIII presents the average seconds for 10 revolutions on the antenna assembly under no added load. Two

Continued on next page

IT'S A FAR CRY from the exact, painstaking investigation by Messrs Baniak and Barnett (see above) and their test project whereby the grease on the accessory equipment could be measured as to performance, to actual aerial lubrication, circa 1930.

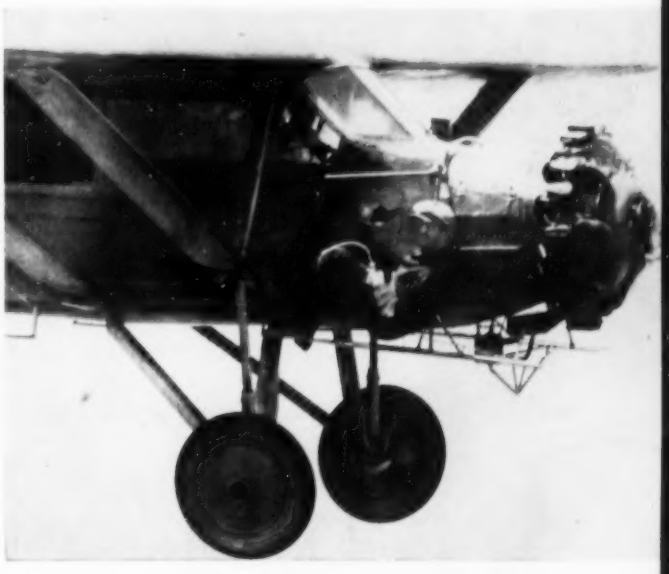
Endurance records in the air were all the rage 26 years ago, and this meant that engine rocker arm lubricant was regularly applied by hand gun . . . in full flight, the flyer standing there greasing within inches of the whirling propeller blades. A narrow catwalk supplied access to the engine as the plane circled high in the air.

Such an endurance record was achieved in 1930 over Sky Harbor, Chicago, when the four Hunter brothers made a 554 hour flight. Ken Hunter, now chief pilot for the Kerr-McGee fleet, regularly greased the rocker arm mechanism from this lofty perch.

LUBRICATING IN 'THE GOOD OLD DAYS' THE AIR

Deep Rock gasoline and Deep Rock lubricants were used exclusively, and although rocker arm lubricant was a fairly good seller at the time, the method of application pictured above was one not generally undertaken nor recommended.

Bill Murray, president of NLGI, was manager of Deep Rock's lubrication department at the time and was an interested spectator. Deep Rock is integrated with Kerr-McGee Oil Industries now, and many old friends are again united.



WEATHER made a difference in the attire that Ken Hunter wore during his record-breaking endurance flight, but these two pictures prove that the lubricating job went on during the 554 hours in the air.

findings immediately stand out from these data: firstly, this accessory generally is under-powered and stalled nine times in 12 runs at −65°F. even with the MIL-G-7421A Grease D. Secondly, Unit No. 2 possesses significantly more power than Unit No. 1, as shown by the shorter times for rotation and by the fact that it started twice at −65°F. with Grease B (MIL-G-3278 Specification) and once with Grease D; whereas, Unit No. 1 stalled at −65°F. with all the greases.

TABLE IX

Antenna Assembly (Tilt)

Average Seconds to Tilt Complete Travel of 40 Degrees*

Greases	*MIL-G*	*Unit No. 1*		*Unit No. 2*	
		77°F.	*−65°F.*	*77°F.*	*−65°F.*
A	3278	10.4	Stalled	10.2	19.0
B	3278	10.7(11.6)	Stalled(ck.)	11.6(12.2)	32.9(52.7)
C	3278	11.0	Stalled	13.8	Stalled
D	7421A	9.9(10.4)	21.3(38.8)	11.1(13.4)	29.9(36.6)
			0°F.		0°F.
E	None	12.0	21.9	19.8	36.2

Run in accordance with instructions

*Average of two travels (both directions). ( ) = test repeated

Table IX presents the average seconds to tilt the assembly over its complete travel of 40 degrees. Here, Grease D allowed satisfactory operation on both units at −65°F.; whereas, the other greases all stalled at −65°F. for Unit No. 1. However, on Unit 2, two of the MIL-G-3278 products (A and B) allowed satisfactory operation at −65°F., thus confirming the greater power output of this unit as compared to Unit 1.

In all tests on the antenna assembly, Grease E would not operate at temperatures below 0°F.

Greases which ran satisfactorily at −65°F. on the above accessory were also tested at −100°F., but operation could not be obtained with the power available.

Summarizing Statement

It may be seen from this work that power requirements of accessories are overriding factors in performance, minimizing small differences in grease torques which may be detected with sensitive laboratory apparatus.

As a final word, it is cautioned that terms such as "good at −65°F." or "good at −100°F.," when applied to grease performance, always should be qualified by a description of the type of equipment in which the low temperature data were obtained. For instance, the Retractable Landing Light tested in the above work made all of the greases "good at −100°F."; whereas, Antenna Unit No. 1 would not rotate at −65°F. with any of the greases.

CONCLUSIONS

The following conclusions were drawn on the basis of the results of this investigation, including a statistical analysis of the data:

1. Power requirements of accessories are overriding factors in performance, minimizing small differences in grease torques which may be detected with sensitive laboratory apparatus.

2. There was as much variation in the low temperature power requirements of the accessory units of the same design as there were variations attributable to the performance of similar greases.

3. When lubricated with MIL-G-3278 or MIL-G-7421A greases, the power available was sufficient for operating to −100°F. in all integrally motorized equipment except the Antenna Assembly.

4. There was no definite correlation between the results of the low temperature torque tests (carried out in No. 204 ball bearings) and the results of the tests on actual aircraft accessory equipment.

5. Grease D was superior to all other greases.

6. Greases A and B were approximately equivalent and slightly superior to Grease C.

7. Grease C was definitely superior to Grease E.

TABLE X

Physical and Chemical Tests

MIL-G-Specification	3278			7421*A*	*None*
Lubricant	A	B	C	D	E
Li Soap %	24.8	18.1	21.5	19.3	..
Na Soap, %	..	..	..	..	16.9
Oily Component, %	75.2	81.5	78.4	78.5	79.3
Dropping Point, °F.	365	377	364	362	414
ASTM Penetration					
Worked 60 Strokes	262	314	270	286	265
Worked 100,000 Strokes	295	368	358	302	400+
Apparent Viscosity, Poises at −65°F.					
20 sec. $^{-1}$	10,600	5,600	4,800	2,650	33,000

ACKNOWLEDGMENTS

The authors wish to express their appreciation for the valuable aid throughout this work of Messrs. E. F. Koenig, Supervisor; E. M. Johnson, Assistant Supervisor; and D. K. Nason, Group Leader; all of the products Application Department of Beacon Laboratories.

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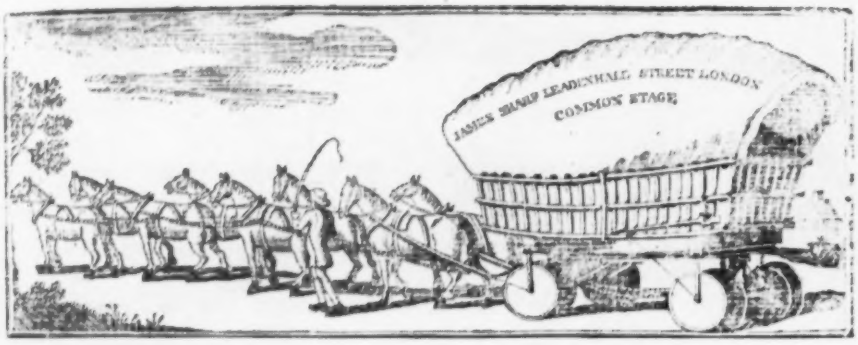

General Directions for the Driver of the Rolling Waggon.

LET the Waggon be greaſed as often as you conveniently can, whilſt it is new.

Be careful that you replace all the Rings or Waſhers, and examine the Boxes often (as they may be liable to get looſe at firſt) and wedge them up tight.

Hook up the Back Bands of the Thiller Horſes very ſhort,* that the Cattle may draw upwards as much as poſſible, and let the Body Horſes (or the Pair next the Thillers) have Pads or Saddles on their Backs, to ſuſtain the Preſſure occaſioned by the Leaders.

Load the Waggon forward, and leave the hind Part as light as poſſible.

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Note, It is abſolutely neceſſary that this ſhould be ſtrictly obſerved, for if it is not, the Thill and Body Horſes will ſoon be gall'd upon the Top of the Neck, by the too great Preſſure of the Collars, which will be entirely taken off when the back Bands are hook'd up ſhort.

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Early Posters or NLGI's Modern "Recommended Practices,"

Important Maintainence of Equipment Should Be

Done with Proper Care When Using Grease Lubricants

and Lubricate Properly

"LET THE WAGGON be greased as often as you conveniently can, whilst it is new.

"Be careful that you replace all the Rings or Washers, and examine the Boxes often (as they may be liable to get loose at first) and wedge them up tight."

This poster for a common stage or freight line (James Sharp, Leadenhall Street, London) admonished drivers to take care of their wagons in the 1700's by greasing—part of the general directions for the driver of a "Rolling Waggon." Then as now, lubricating greases were important if you wanted your "Waggon, Rolling Carriages or Land Rollers" to actually *roll* in the 18th Century.

Today it takes more than just a poster with a reminder to replace the washers . . . the complex nature of modern rolling carriages—automobiles, brought about the need for comprehensive lubricating procedure for front wheel bearings. This need was met by NLGI's booklet, *Recommended Practices for Lubricating Automotive Front Wheel Bearings* . . . more than twenty Institute members collaborated in the preparation of an accepted procedure manual, which was first offered in late 1954 as a sixteen-page booklet, selling for fifteen cents.

Now, four editions later, more than 90,000 copies of *Recommended Practices* have been sold through the Institute national offices to firms, schools, libraries, manufacturers and technical men. With distribution here and abroad, the booklet has even been translated into Norwegian. A goodly per cent of the orders received have been sent out with the distributor's own company imprint, as an advertising and public relations gesture. The manual has been particularly popular with service station dealers.

TYPICAL illustration from "Recommended Practices"—detailed instructions accompany each step.

Each step outlined in the manual is profusely illustrated, with clearly printed instructions accompanying every phase . . . from names of wheel bearing parts through disassembly, cleaning, inspection, lubrication, reassembly, adjusting, completion of reassembly and special instructions about wheels with disc brakes—it is all there in understandable form.

For those organizations which would like to order booklets or purchase additional copies to replace earlier copies, quantities can still be supplied at very low cost (see box) with or without company imprint at the bottom of the back cover. Company emblems can be included with the imprint order at no extra cost, but the plate must be furnished by the customer. Shipping charges are f.o.b. Kansas City, Missouri.

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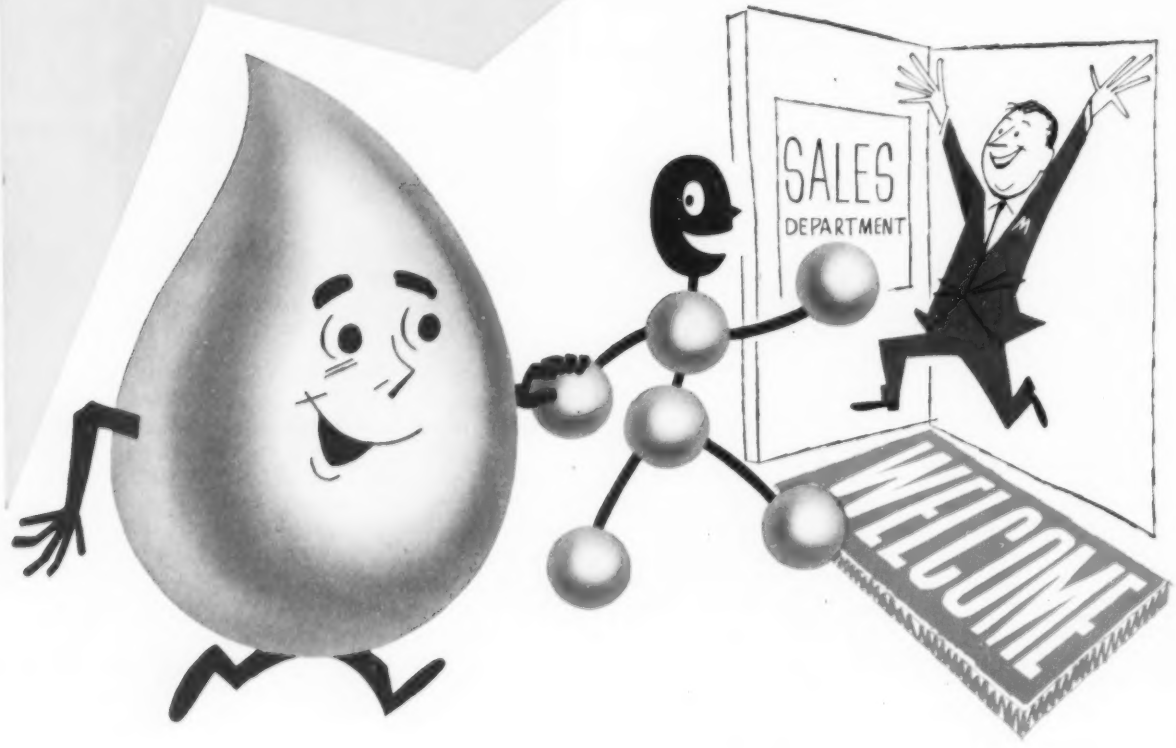

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The Service Station and Automotive Service:

what happens tomorrow?

In a special interview with Raymond Shaw, president of the Chek-Chart Corporation of Chicago, NLGI SPOKESMAN readers get the advantage of Mr. Shaw's many years of experience on the marketing scene:

There's been a good deal of talk recently about the future of service stations. Mostly with regard to a lessened need for the type of automotive service they provide. From your vantage point, what do you feel is involved and what do you foresee?

The talk you refer to has occurred frequently in the years of automotive maintenance history. It would seem that whenever new developments in cars arise, one of the first thoughts is that the end of the service station is near. As with most men who have worked long in the field of lubrication and maintenance, I've seen such concern give way to improved service station programs which in turn have been modified by further automotive developments and which, in their turn, have been the motivating force for even finer station programs. One firm conviction I hold is that the service station is an institution capable of extreme diversification.

Figure 1. ". . . the service station is an institution capable of extreme diversification . . . of importance to the maintenance of automotive transportation."

Super Service Station photos.

I believe the type of automotive service which can be provided by the service station is of importance to the maintenance of automotive transportation. The comfort and safety resulting from regular care—which the station can conveniently offer the motoring public—will always be in demand.

In actual form, the work will, of course, depend upon future automotive requirements. There have been frequent opinions, some well based, about what the car of the future will be like. In the future, and I'm speaking of what is referred to as the far distant future, there will undoubtedly be a car with some completely sealed parts from the lubrication standpoint. There will also be, for general use, vehicles powered by energies other than those presently used. It will take time and exactly what services the station will perform cannot entirely be determined at the present moment. In the meantime, we

have the immediate future—and there are hundreds of thousands of pre-war and post-war model cars on the road in need of regular lubrication maintenance. In addition, there are, and will be for a long time to come, cars of a contemporary nature which will require both plain and specialized lubrication services. This also is the future.

In mentioning contemporary cars and specialized service, do you think there is a great difference between maintenance the service station of today must provide as compared with the past?

Our organization recently noted in their promotional material that better cars require better service. The observation is quite accurate. Behind that expression lies the crux of the matter about differences between past and present automotive maintenance programs. The contemporary car is more in need of careful and thorough service than any equivalent vehicle has ever been. The continuing vital factor of correct lubrication has been augmented by an increase in the importance of proper maintenance of all systems and units of the car. We are beyond that point where the little-service-here-little-service-there of the past even approaches adequacy.

Figure 2. ". . . complete lubrication service means many things."

This contemporary car we speak of has gone further into the technical stage where the interdependency of all units demands regular service of inspection of the whole car at regular intervals. That's why the advice, "Lubricate for safety every one thousand miles," is still good advice, especially when a maintenance program includes, as it should, complete automotive inspection during the one thousand mile service. All such work involved is well within the realm of the service station.

Figure 3. ". . . Today to an ever increasing degree, the lubrication bay of any station definitely offers the greatest profit."

There is another expression that serves to illustrate my point: *complete lubrication service means many things*. It sums up rather well the concept of multiple service. Not only chassis lubrication but the regular inspection and maintenance of lubricant levels, of units calling for special mileage services, of accessory equipment—in short, complete care for the operating parts of the entire car. The car of today, being particularly designed to perform as an integrated machine, with especial regard to its various systems and units, must consequently be maintained through integrated service.

With an adoption of the type of service you speak of Mr. Shaw, do you visualize the service station as a new kind of specialized maintenance center taking over work done now by other sources of automotive maintenance?

I would say no. The value of the service station to the public, and to itself, lies in the retention of its position as a motoring way station. In this respect, one could compare the position to that of the old stagecoach way station. There the intention was not to replace the coach maker but simply to provide a large number of maintenance points where the vehicle—and the horsepower—could continually be kept in good operating condition. However, keeping today's car in good operating condition is considerably more complicated and the matter is carried back to your preceding questions.

Then may I assume that you would place emphasis upon maintenance service in a station program above everything else? And if so, would you express your opinion about service station profit possibilities as they appear today?

To answer the first part of your question, yes, I would place the heaviest emphasis upon the area of automatic maintenance. To answer the second part, such emphasis would be bound to create profit possibilities. Today to an ever increasing degree, the lubrication bay of any station definitely offers the greatest profit. The prominent difference between the successful station and the station that just manages to survive has been and will continue to be mainly a reflection of the automotive maintenance program. It is a program which, while not limited by the actual confines of the lubrication area, is centered there.

According to the Du Pont survey, service is the most popular attraction afforded by the station. My experience bears out that finding completely, but from that

Figure 4. "... the windshield cleaning cloth and the whisk broom are the two most important tools a service station possesses."

point on it becomes a matter of delineating the idea of service. From the profit standpoint, the first job of the station naturally is to attract customers. The second, to hold them. One poorly or carelessly treated customer usually costs a station more than it is ever aware of.

Probably one of the most common errors made in the field is to consider the man in the car as primarily a car owner or a motorist. First an individual personality, his rank as a motorist is of much less importance since between the idea of the personality and the action of being a motorist lie a variety of interests and responsibilities. It's only good sense, and good business, to approach him at the initial human level. While the so-called premium giveaway may half arouse his interest in something comparatively free, as a human he's most receptive to a small, considerate service regularly given. In this respect, the windshield cleaning cloth and the whisk broom are the two most important tools a service station possesses. Profit for both motorist and service station begin at that point—its continuation is mainly dependent upon the interest of the station operator.

There has been a great deal written about each individual service falling to the lot of station work. I don't

Figure 5. "Technically there is no difficulty that remains such for very long if available tools and petroleum products are properly utilized."

believe I need enumerate each accessory item or lubricant involving inspection, service, replacement or repair. What does need to be emphasized and reemphasized is that profit, especially from now on, will hinge upon a program of *complete* service. It is becoming more questionable whether or not stations predicated on sales that drift between gasoline, lubricant make-up and the quick service job will even be able to survive in the future. Profit for today's station will increase dependent upon the extent to which station personnel adapt a legend comparable in meaning to *complete lubrication service means many things.*

Do you feel that there will be difficulties encountered by the service station in operating a program of complete maintenance which were not met before?

Basically, no more so than previously, no. The primary difficulty to be met by any service station, if such is the case, lies with the human factor. Technically there is no difficulty that remains such for very long if available tools and petroleum products are properly utilized. But when I said "properly" the subject goes back to the human factor.

Automatic transmission service, which appeared strongly on the service station scene following World War II, is an excellent example of a type of difficulty to be met by the service station as well as by the oil company. Technically there were no problems since the tools, the lubricants and the service instructions were readily available. But frequently station personnel would, and still do for that matter, shy away from automatic transmission service for fear they would not do the job properly, having heard of damage claims against a station that failed to render correct maintenance. This is the type of human difficulty I refer to and the first way to combat it is to continue to strengthen training programs wherever possible.

Certainly one thing is strongly apparent. This matter of automatic transmission service is a representative part of

Continued on page 28

NLGI Associate and Technical Mem

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Figure 6. "This matter of automatic transmission service is a representative part of the complete lubrication service upon which the individual station of today and tomorrow will stand or fall."

the complete lubrication service upon which the individual station of today and tomorrow will stand or fall.

(*At this point, Mr. Shaw was asked to summarize his thinking about the concerns rampant in that part of today's petroleum industry immediately occupied with automotive service.*)

If your members, and others interested, can keep the matters I've been talking about in proper perspective, they will not only have an understanding of the actual situation but they will be in a position to counteract the unfortunate degree of fear voiced from one quarter or another every day. American ingenuity, as an old friend wrote me some time ago, will maintain a balance in our industry. He's right.

The future doesn't rest with those who stop planning, stop building, stop developing. The future is an attitude of mind that looks out upon a time to come which is always interesting. In my view, and taking into consideration the interests of your readers, the future is greatly to be looked forward to for it will provide countless opportunities to prepare more useful and diversified products which will contribute to better preventive maintenance of transportation.

The automotive lubrication needs of today, as I've said, will be with us for a long time. The oil industry has always met its tomorrows and come out the better for it.

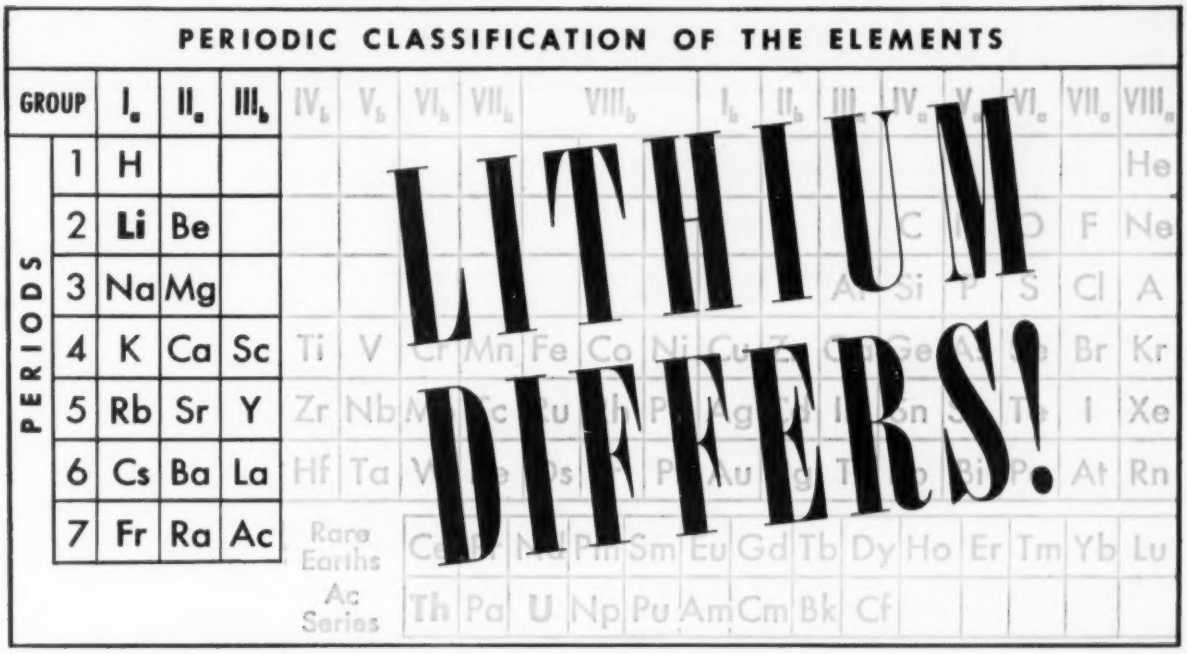
Figure 7. "The future is an attitude of mind that looks out upon a time to come which is always interesting."

Things to come in the NLGI SPOKESMAN

The article about the interview with Mr. Raymond Shaw of the Chek-Chart Corporation (above) marks the first of a marketing series which will be included in the pages of the NLGI SPOKESMAN, as requested by readers in a recent survey. A committee chairmanned by Board Member D. P. Clark of the Gulf Oil corporation is now preparing timely articles of interest which will highlight various marketing factors for the industry.

Technical articles will continue to feature latest developments in grease lubricants, and articles of reader interest in forthcoming issues include a study of "The Use of Aerogels for Examining Structure of Lubricating Grease Thickeners" by A. L. McClellan and J. Cortes, Jr. and a summary of research carried on by the Naval Research Laboratory in Washington, in the field of greases for specialized uses.

These and other special features will come in the future, making your NLGI SPOKESMAN truly the voice of the lubricating grease industry.



Lithium, by reason of its atomic configuration and general characteristics, is rightfully included as the first member of Group I in the Periodic Table. A detailed study of the properties and reactions of both the elements and their compounds, however, shows that Lithium often resembles the metals of Groups II and III more closely than Group I. Following are some characteristic differences:

Lithium differs in organic chemistry . . .
because its organolithium compounds form a unique class with stability, solubility and activity characteristics intermediate between those of the Group I and Group II organometallic compounds.

Lithium also differs from the other alkali metals in that it serves as a unique catalyst for the polymerization of diolefins to materials of definite and predictable structure. It directs, for example, the polymerization of isoprene predominantly to 1,4 addition structures.

Again, recent investigations have indicated an interesting potential as a direct reducing agent in solvents such as ammonia, low molecular weight amines, and ethylenediamine.

Lithium differs in metallurgy...
inasmuch as the affinity of Lithium for oxygen, for example, is being utilized to reduce porosity in copper and copper alloy castings. Recent research has revealed that Lithium will produce brazing alloys with self-fluxing properties and increase the wetting ability of these alloys.

Lithium differs in inorganic chemistry . . .
the usefulness of Lithium Hydride and Lithium Aluminum Hydride in the preparation of other hydrides having already been widely demonstrated. Recent studies indicate that other complex hydrides prepared in a similar manner may prove to be interesting tools for research. The low dissociation pressure of Lithium Hydride at its melting point, to cite a specific example, is unique among all hydrides. LiH also has some slight solubility in polar organic compounds which is again unique among alkali metals.

Lithium differs in heat transfer . . .
based on its physical properties it has no equal as a liquid metal coolant. Due to corrosion caused at elevated temperatures by impurities in commercially available Lithium and Lithium Metal, Lithium has thus far found only experimental use.

Why don't *you* take a long look at Lithium? Its uniquely valuable differences in so many diverse fields may prove of great interest—and profit—to *you*. Write our PR&D department giving us details of the application you have in mind. Experimental quantities of Lithium Compounds are available on request.

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Patents and Developments

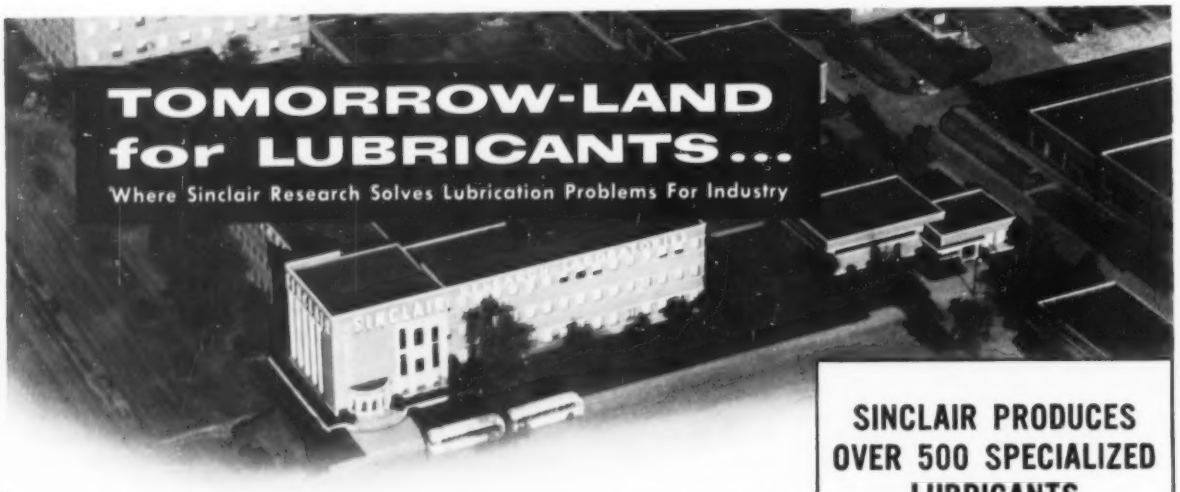
Lithium-Strontium Oxidate Soap Greases

It is well known to employ oxidized petroleum fractions as the saponifiable material in grease making, and greases have been prepared from such materials employing various metals as the metal component of the waxate soap. However, these oxidates are considerably different in many respects from the natural fats and fatty acids in their grease making properties, and difficulties have been encountered in producing greases of the desired properties from these materials. The chief difficulty, which has been found in a greater or less extent with all greases of this type is their tendency to harden, or "set up," in storage. This hardening is very objectionable from the standpoint of marketability, and also seriously impairs the service characteristics of the greases for many purposes.

In accordance with U.S. Patent 2,738,327, issued to the Texas Company, very superior lubricating greases, having both excellent lubricating properties and storage characteristics, are said to be obtained by employing, as the essential thickening agent, a mixed lithium-strontium soap of a saponifiable material resulting from the oxidation of a petroleum fraction, the mixed lithium-strontium soap comprising substantial proportions of each metal soap. The soap may suitably comprise lithium and strontium oxidate soaps preferably in a proportion of about 1 to 1 to about 4 to 1 by weight. This mixed base soap is employed in a suitable oleaginous vehicle in varying amounts to produce greases for various purposes ranging from semi-fluid to very stiff. Ordinarily, the soap content of the grease will be from about 10 to about 45 per cent by weight.

The oxidates are oxidized petroleum fractions containing considerable proportions of saponifiable materials, or separated saponifiable factions of such oxidized petroleum fractions such as have been employed heretofore in grease making. They are obtained by oxidizing a petroleum fraction such as a lubricating oil fraction, crude or refined wax, slack wax, or petrolatum at elevated temperatures, by means of an oxidizing agent such as air or oxygen, and in the presence or absence of a catalyst. Preferably, the oxidates employed for this purpose are highly oxidized materials having saponification numbers in the range from about 175 to about 450.

The mixed lithium-strontium soaps are prepared from the petroleum oxidates by any of the conventional methods employed for obtaining mixed base soaps, such as by coprecipitation or by mixing separately prepared lithium and strontium soaps. They are most conven-



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iently prepared by the coprecipitation method, that is, by saponification of the oxidate with lithium and strontium hydroxides or other suitable compounds to produce directly a mixed soap of the desired ratio of lithium and strontium soaps. An excess of lithium or strontium hydroxite, or of both lithium and strontium hydroxides, beyond the amounts required to react with all of the saponifiable matter is employed in the saponification. Preferably, an excess of lithium or strontium hydroxide is added sufficient to give a free alkalinity of about 0.01 per cent to about 10 per cent by weight of the finished grease. In addition to these special soaps, the greases may contain any of the usual additives such as, for example, oxidation and corrosion inhibitors, extreme pressure agents, oiliness agents and so forth, as well as small amounts of additional thickening agents such as polymeric materials and solid lubricants such as carbon black. These greases may also be mixed or blended with greases of other types if desired to produce greases of special properties.

The grease preparation is suitably carried out by charging a quantity of oxidate together with lithium and strontium hydroxides in proportionate amounts to a conventional grease making kettle, where the mixture is maintained at elevated temperature below about 220° F. with stirring, air blowing or other mechanical agitation until the saponification is complete. The temperature is then increased to about 270° F. or higher and maintained at this increased temperature for a time sufficient to accomplish dehydration. The lubricating oil included in the grease is preferably added to the initial charge also, or only a small amount of the oil may be added to the initial charge and additional oil added during the saponification or after the dehydration to obtain a grease of the desired consistency. Other saponifiable materials such as the natural fats and oils commonly employed in grease making may also be added where it is desired to obtain a mixed grease.

Greases prepared from mixed lithium-strontium oxidate soaps, as described above, have been found to have very different storage characteristics from the other petroleum oxidate greases of the prior art, in addition to generally excellent lubricating characteristics equivalent to those obtainable with the very expensive highly refined natural fats and fatty acids. It is particularly surprising that oxidate greases of excellent lubricating characteristics are obtained employing this combination of metals, since attempts to produce greases employing both lithium oxidate soaps and strontium oxidate soaps separately have given very unpromising results, the greases produced being gel-like and unsatisfactory in texture and softening to an objectionable degree upon working. For example, a grease comprising 20 per cent of lithium oxidate soap in a naphthene base lubricating oil having a Saybolt Universal viscosity at 100° F. of about 300 seconds, has an unworked penetration (ASTM) at 77° F., after two days, of 174 and a worked penetration of 274. A grease comprising 20 per cent of

strontium oxidate soap in a lubricating oil of the same type had an original unworked penetration of 217 and a worked penetration of 312, and, in addition, it had a very low dropping point of only 222° F. However, greases prepared according to this patent by employing both lithium and strontium oxidate soaps, in combination, have been characterized by excellent texture, and have tended to harden slightly rather than to soften upon working. In addition, these greases very unexpectedly showed no hardening upon storage even for long periods of time.

Complex Grease Containing Hydrogenated Castor Oil

Soap salt complex thickeners have been employed for high temperature greases and consist of combinations of metal salts of low molecular weight carboxylic acids with metal soaps of high molecular weight fatty acids. Normally in the prior art, the soaps and salts have been employed in proportions in the range of about 0.5 to 3 moles of salt per mole of soap since, in general, it was believed that, in order to make greases of satisfactory penetration characteristics, it was necessary to employ a high proportion of the soap-salt thickener when the mole ratio of salt to soap exceeded about 3, because of the low thickening effect of the salt.

However, recently it has been found that by drastically increasing the salt content and with it the metal content of soap-salt complexes, entirely new properties may be built into these new complexes which, in addition to extending the scope of their utility to entirely new fields, also greatly increase their value as grease thickeners.

According to Esso Research and Engineering Company's U. S. Patent 2,738,328, complexes of metal salts of low molecular weight carboxylic acids with metal salts of high molecular weight carboxylic acids which contain at least 7 moles and up to as much as 40 moles or more, preferably about 10 to 25 moles, of the low molecular weight acid per mole of the high molecular weight acid have outstanding load carrying, dispersant and various other beneficial characteristics in addition to thickening properties comparable to soap-salt complexes containing substantially lower proportions of low molecular weight carboxylic acids.

In these high metal content grease compositions, one of the high molecular weight carboxylic acids employed to form the soap portion of the soap-salt complex has been derived from hydrogenated castor oil. A particularly preferred complex thickener has utilized a combination of hydrogenated fish oil acids and hydrogenated castor oil which were co-saponified with acetic acid in situ in the lubricating oil. In these grease compositions, the hydrogenated castor oil soap imparts not only structural stability to mechanical working but also prevents crust formation on the surface of the grease when stored in a container.

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It has been found, according to the patent, that excellent greases having improved structural stability to mechanical working and improved resistance to storage hardening and accompanying crust formation, are prepared by employing unsaponified hydrogenated castor oil as such in the finished grease compositions. These greases are softer, that is, they have higher penetration for given amounts of soap than do the other greases mentioned above, which makes the new greases easier to handle.

The greases comprise a major proportion of lubricating oil and a grease-making proportion, preferably about 10 to 25% by weight based on the total composition, of a thickener consisting essentially of (1) a soap-salt complex of at least one alkaline earth metal soap of at least one high molecular weight carboxylic acid and at least one alkaline earth metal salt of at least one low molecular weight carboxylic acid, the molar ratio of low molecular weight carboxylic acid radical to high molecular weight carboxylic acid radical in the complex being in the range of preferably about 8:1 to 25:1, and (2) hydrogenated castor oil, the weight ratio of the hydrogenated castor oil to the soap in the thickener being in the range of preferably 1:2 to 2:1. The preferred alkaline earth metal is calcium, and acetic acid is the preferred low molecular weight carboxylic acid. Hydrogenated fish oil acids have been found to be especially useful as the high molecular weight carboxylic acid employed in forming the soap-salt complex.

The greases are generally prepared by mixing at least one high molecular weight carboxylic acid, at least one low molecular weight carboxylic acid, and a basic reacting compound of at least one alkaline earth metal with at least a portion of the lubricating oil, and heating the mixture to an elevated temperature in the range of about 450° to 550° F. to dehydrate the mixture and form the soap-salt complex. Thereafter, the mixture is cooled to a temperature below about 350° F. and the hydrogenated castor oil is added thereto. It has been found that in this method of preparation there is essentially no saponification of the hydrogenated castor oil.

Suitable low molecular weight carboxylic acids include saturated and unsaturated aliphatic mono- and poly-carboxylic acids having about 1 to 6 carbon atoms such as formic, acetic, propionic, furoic, acrylic, adipic, and similar acids including their hydroxy derivatives such as lactic acid, etc. Acetic acid is particularly preferred.

The high molecular weight carboxylic acids are those having about 12 to 30 carbon atoms and preferably those having 18 to 22 carbon atoms per molecule. These acids may be derived from straight or unsaturated naturally-occurring or synthetic fatty materials. The fatty acids normally used in the manufacture of conventional greases, particularly the more saturated acids, are preferred. Examples of such acids include stearic, hydroxy-stearic such as 12-hydroxy-stearic, di-hydroxy stearic, poly-hydroxy stearic and other saturated hydroxy fatty acids,

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arachidic, hydrogenated fish oil and tallow acids, etc. However, unsaturated acids such as oleic, ricinoleic and similar acids may likewise be used.

Hydrogenated castor oil is a synthetic wax-like compound obtained by the substantially complete hydrogenation of castor oil. The principal constituent is the glyceride of 12-hydroxy stearic acid. There are also present minor quantities of mixed glycerides of this acid and di-hydroxy stearic and stearic acids. The hydrogenated castor oil, which is a hard, brittle, high-melting point product, is practically odorless and tasteless and is available commercially either in the form of uniform, free-flowing white flakes or as a powder. Typical physical and chemical properties of a particularly commercially available hydrogenated caster oil are as follows:

Physical Properties:

Specific gravity @ 20° C.	.99
Melting point, °C.	86 (187° F.)
Ash content, per cent	.005
Di-electric constant (.IKC) at 30° C.	12
Flash point, COC, °F.	600
Fire point, COC °F.	635

Chemical properties:

Acid value	2
Iodine value	4
Saponification value	180

The grease thickener of this patent consists essentially of (1) the soap-salt complex of the aforementioned low and high molecular weight carboxylic acids and (2) the unsaponified hydrogenated castor oil. The proportion of this thickener employed in the lubricating grease composition will be preferably about 10 to 25% by weight, based on the total composition. An especially desirable proportion is in the range of about 16 to 18% by weight. In the soap-salt complex, the ratio of the low molecular weight carboxylic acid radical to high molecular weight carboxylic acid radical is preferably about 8:1 to 25:1. In an especially desirable grease composition, this ratio is about 20:1. The preferred alkaline earth metals employed are calcium, barium, strontium and magnesium, calcium being especially preferred. The hydrogenated castor oil is employed in these lubricating grease compositions in an amount such that the weight ratio of the hydrogenated castor oil to the soap in the thickener is in the range of preferably about 1:2 to 2:1. Approximately equal proportions by weight of the hydrogenated castor oil and the soap have been found to be particularly useful.

The lubricating oils useful in preparing these lubricating grease compositions generally should have a viscosity within the range of about 35 to 200 S.S.U. at 210° F. and flash points of about 350° to 600° F. A viscosity index of 100 or higher may be employed if desired. However, oils of lower viscosity index, such as below about 60 V.I., give better yields. The lubricating oil portion of the grease composition preferably comprises about 55 to 90% by weight of the finished grease.

Soap-salt complexes containing more than about 30 moles, for example, 30 to 40 moles, of low molecular weight acid for each mole of high molecular weight acid have particular utility for converting synthetic oils of the ester type into excellent greases.

Although it will be understood that the soap-salt complex may be prepared in a separate step, in the preferred embodiment, the high and low molecular weight acids are co-neutralized with a basic reacting compound, such as a hydroxide and/or a carbonate of the alkaline earth metal in situ in a portion or all of the lubricating oil. A sufficient amount of the alkaline earth metal basic reacting compound is employed to neutralize the high and low molecular weight carboxylic acids. After these three ingredients have been mixed with the lubricating oil, the mixture is heated to an elevated temperature in the range of about 450° to 550° F. or higher in order to dehydrate the product and to promote formation of the soap-salt complex. The lubricating oil employed should, of course, have a boiling point above the heating temperature. Generally a period of heating at about 500° F. of about 10 to 30 minutes will be required to promote formation of the complex. Heating of the mixture at this temperature may be continued for an additional period of time if desired.

After the mixture has been dehydrated and the complex has formed, the grease is then cooled to a temperature below about 350° F., at which point the hydrogenated castor oil is added. It is important that the hydrogenated castor oil not be added to the mixture prior to this point in the grease-making procedure. This is because hydrogenated castor oil is subject to saponification in the presence of water and/or excessive heat. In addition, the unsaponified hydrogenated castor oil may be decomposed at the high temperatures (450°-550° F.) involved in forming the soap-salt complex. It is, therefore, important that the hydrogenated castor oil be added after the mixture is substantially completely dehydrated and after the mixture is cooled to a temperature below about 350° F. After the hydrogenated castor oil is added, the resultant grease composition may then be cooled further, homogenized, filtered and packaged.

It will be understood that other conventional thickeners such as polyethylene, etc., anti-oxidents such as phenyl alpha-naphthylamine, N-lauryl para amino phenols; etc., tackiness agents such as polybutene, etc. and the like may be added prior, during or after the heating step.

Additional Patents

U.S. 2,737,331—(John R. Kimpan)—Grease gun cartridge.

U.S. 2,738,902—(Tecalemit Ltd.)—Grease guns and like lubricant dispensing devices.

U.S. 2,741,326—(Morehouse Industries)—Grease deaerating mechanism.

U.S. 2,744,659—(Gibbs U. Melchor)—Grease gun nozzle.

U.S. 2,744,664—(American Flange & Mfg. Co., Inc.)—Dispensing gun.

U.S. 2,746,778—(Fred F. Hurlburt and Charles H. Gillispe)—Journal box grease seal.

U.S. 2,746,817—(Hennessy Lubricator Co.)—Railway axle journal lubricator.

Speakers... NLGI ANNUAL MEETING

EDGEWATER BEACH HOTEL, CHICAGO, OCTOBER 22-24, 1956

Given below are most of the speakers and program participants of the October NLGI annual meeting.

Professor H. M. Alyea
Frick Chemical Laboratory
Princeton, New Jersey

Ray Ashworth
Director, Traffic Institute
Northwestern University
Evanston, Illinois

C. R. Bergen
Continental Oil Co.
Ponca City, Oklahoma

C. F. Carter
California Research
Richmond, California

J. L. Dreher
California Research
Richmond, California

J. H. Flanagan
Standard Oil Co. (Indiana)
Chicago, Illinois

H. K. Gandelot
Engineer in Charge
Vehicle Safety Section
General Motors Corp.
Detroit, Michigan

C. E. Gore
Battenfeld Grease & Oil Corporation
Kansas City, Missouri

F. R. Hart
Standard Oil Co. (Calif.)
San Francisco, California

W. B. Hotten
California Research
Richmond, California

Dr. H. L. Leland
Esso Research & Engineering Co.
Linden, New Jersey

W. A. Magie
Magie Brothers Oil Co.
Franklin Park, Illinois

E. W. Nelson
Continental Oil Co.
Ponca City, Okla.

A. S. Randak
Sinclair Refining Co.
New York, New York

D. F. Rhodes
Canadian Oil Co., Ltd.
East Montreal, Quebec, Canada

W. P. Scott
Continental Oil Co.
Ponca City, Oklahoma

J. E. Simonds
Director of Dealer Training
Esso Standard Oil
New York, New York

E. E. Smith
Climax Molybdenum Co.
New York, New York

A. E. Spottke
Vice President
All State Insurance Co.
Skokie, Illinois

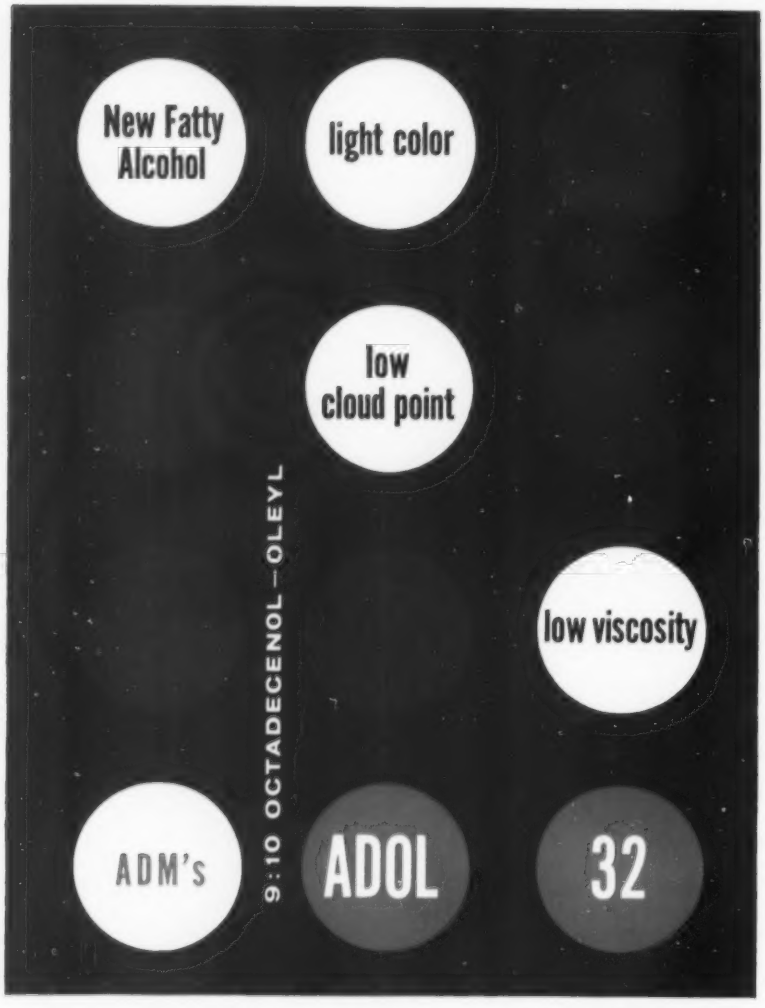
Dr. J. V. Starr
Esso Standard Oil Co.
New York, New York

R. M. Tillman
Continental Oil Co.
Ponca City, Okla.

W. W. Woods
Supervising Research Chemist
Continental Oil Company
Ponca City, Oklahoma

James C. Zeder
Vice President
Chrysler Corporation
Detroit 31, Michigan

KEYNOTE SPEAKER—James C. Zeder, vice president of engineering, The Chrysler Corporation, will keynote the meeting.



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These characteristics make ADOL 32 ideal as an emollient, a super-fatting agent, and a compound for detergents. Other possible applications—chemical intermediates, surfactants, soaps, germicides, emulsifiers, resins, plasticizers, textiles, lubricating oil additives, cutting oil bases and sulfonates.

ADOL 32, as well as thirty new fatty alcohols (many never before available), is being produced at ADM's new Ashtabula, Ohio, plant. Warehouse stocks are being maintained for immediate shipment in drums or tank cars. Be sure to keep posted by writing for our latest Chemical Reactions Bulletin No. 907R and Specifications Bulletin No. 908A.

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PEOPLE

Southwest Grease Appoints Wilson Simmons Sales Manager

A healthy, corporate growth resulting from steadily increasing sales has made necessary a reorganization of the management team at the House of "GOOD" Grease, the Southwest Grease & Oil Company of Wichita, Kansas.

Of special significance in this reorganization has been the promotion of Wilson Simmons, a former special territory representative, to the position of Sales Manager. In his new office, he will have complete control and supervision of all nationwide sales territories. This appointment represents the creation of a new top level job within this rapidly growing lubricant manufacturing company, for company officers have formerly handled these duties.

New Duties to Stosberg

Other changes include new and enlarged duties for filling and marking superintendent, Kermit Stosberg, and manufacturing superintendent, Walt Pannell.

Concurrent with these personnel changes, the company has obtained approximately 20,000 square feet of additional warehouse and office space adjacent to their present plant location and has purchased additional manufacturing equipment that will, when installed, increase production capacity by 25%.

As always, under this reorganization plan, the primary objective of the company will remain unchanged. Everything possible will be done to manufacture, process, fill and ship "Good" greases in exact accordance with customers' requirements.

in the Industry

Mahon and Huber Promoted by Girdler

John E. Slaughter, Jr., vice president of The Girdler Company, Louisville, Ky., has announced two promotions in the Votator Division, which he heads.

Boyd B. Mahon, Jr. has been appointed assistant sales manager. He was born in Louisville and attended the University of Louisville. Before joining Girdler in 1948 as a sales representative he was a member of the Reynolds Metals Company's sales staff. In 1953 he won the Votator Division's Sales Quota Award, given annually to the sales representative with the best record.

Harold E. Huber has been appointed manager of technical sales. Mr. Huber was born in Louisville and attended the University of Kentucky, where he received a B. S. degree in industrial chemistry and an M. S. degree in organic chemistry. He began his business career with the Standard Oil Company of Indiana, in 1938. He was engaged in exploratory research and pilot plant work before joining Girdler in 1943 as chief process engineer. Prior to being elevated to his present position he was a member of the technical sales department.

Girdler is a division of National Cylinder Gas Company, Chicago.

Girdler's Votator Division designs and manufactures processing apparatus and designs and erects complete processing plants for the fatty oil, food and chemical industries.

Gilman Joins Foote as Director of Industrial Relations

William H. Gilman, Jr., has joined Foote Mineral Company, Philadelphia, Pa., as Director of Industrial Relations, it was announced by L. G. Bliss, President.

Gilman, who was formerly Director of Employee Relations at Brush Electronics, Cleveland, Ohio, is a graduate of the University of Pennsylvania's Wharton School.

In 1948, he joined the faculty of Western Reserve University, Cleveland, and assisted in establishing the School of Business. He was awarded a master's degree in business administration from that University in 1951.

Gilman has had extensive experience in industrial relations, and is a member of the national board of directors of the American Society of Training Directors. He is also an active member of the American Management Association, Industrial Research Group, American Arbitration Association, Society for the Advancement of Management, and other professional groups.

He was formerly a citizen of Springfield, Massachusetts.

Socony Mobil Appoints Central Regional Manager

Appointment of Henry J. Muller as manager of Socony Mobil Oil Company's Central Region, effective July 1, was announced by Vern A. Bellman, manager of domestic marketing. Mr. Muller will succeed H. T. Ashton who will retire after 43 years in the oil industry.

Socony Mobil's Central Region, with headquarters in Chicago, includes five marketing divisions and covers 16 states, extending from Ohio west to Wyoming, Montana, and Colorado; and north from Kansas and Missouri to the Canadian border.

Mr. Muller joined the company in 1912. Starting as a messenger boy, he was successively a clerk, an assistant to a director, and assistant secretary. He was assistant to the president from 1931 to 1934, when he was transferred to Central Region marketing.

In 1943 he was named general sales manager of White Star division, with headquarters in Detroit. He was appointed White Star division manager in 1946 and remained in that post until November, 1955, when he became assistant manager of Central Region.

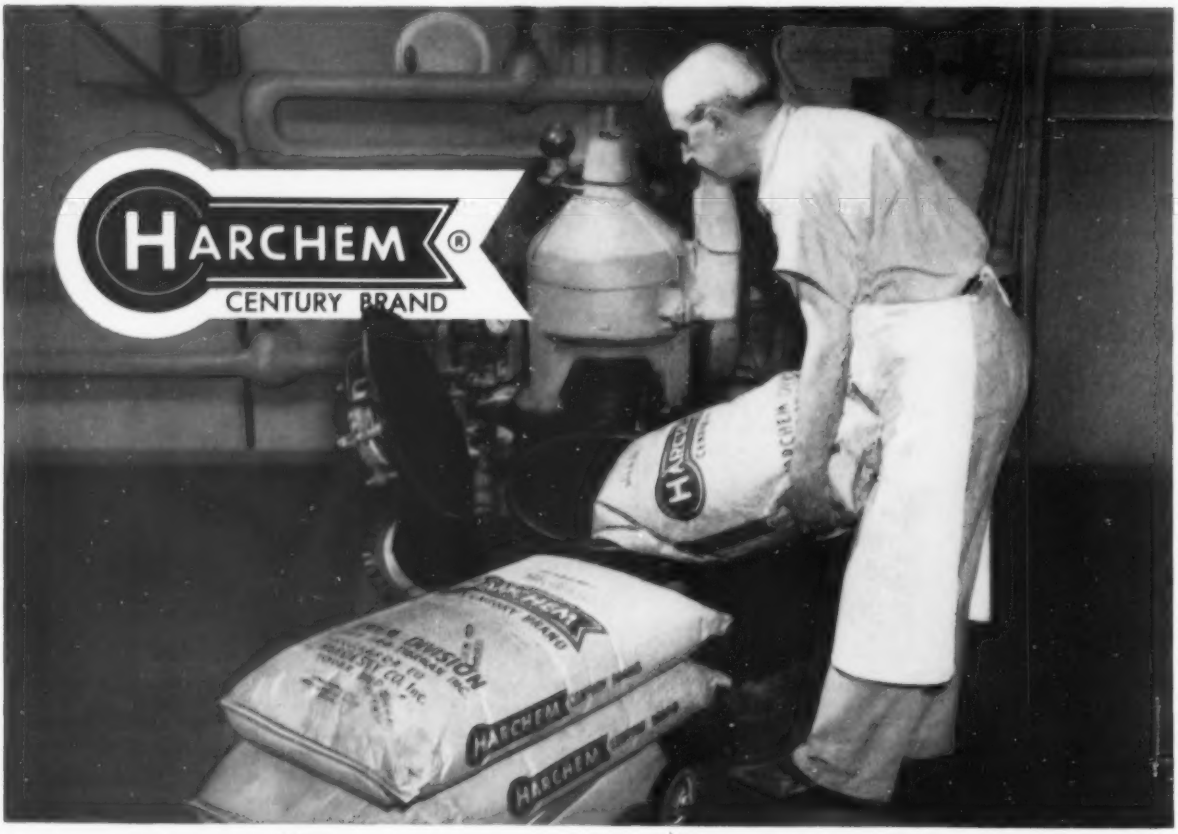
Mr. Muller studied accounting, business administration, finance, law and engineering at various business and professional schools. He is a veteran of World War I. Mr. Muller, his wife, and three daughters will move soon to Chicago from Birmingham, Mich. His son, Henry, Jr., is living in New York City.

Mr. Ashton received an A.B. degree from Miami University in Oxford, Ohio, in 1913, majoring in chemistry, physics and mathematics. He became associated with the Lubrite Refining Company, St. Louis, in 1922 as vice president and general manager. Lubrite later became an affiliate of Socony Mobil, and Mr. Ashton served as manager of Lubrite division. He became manager of Socony Mobil's Central Region in 1946.

Miami University conferred an honorary degree of doctor of science upon Mr. Ashton in 1948 in recognition of services he performed in connection with the oil industry and the war effort.

He is a member of the International Board of the YMCA and has been active in many oil industry committees and organizations.

Mr. and Mrs. Ashton and their son, Holbrook Thayer Ashton II, live at 36 Fair Oaks, Ladue, Mo.



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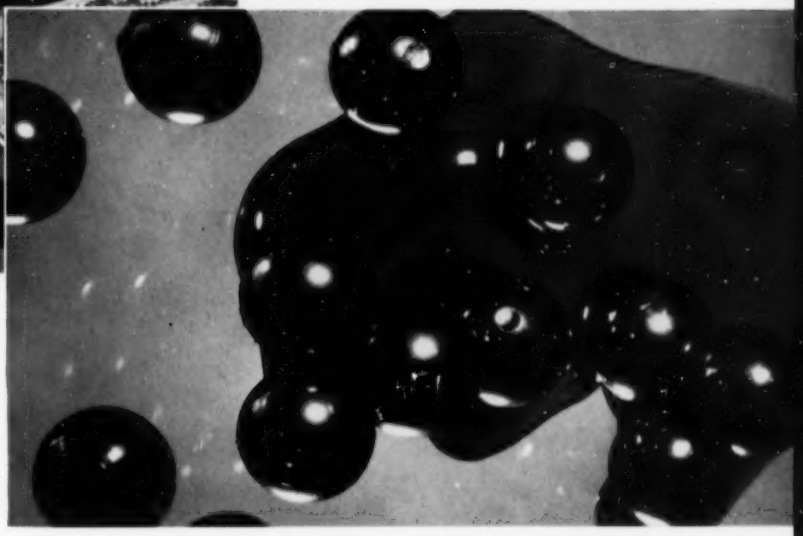
H-8

NEW MEMBER

THIS aerial view shows the bulk of Battelle Institute's American laboratories, located in Columbus, Ohio. Nearly 2500 persons are engaged in scientific research for industry and government at this location and additional atomic energy facilities located in suburban Columbus. Other Battelle laboratories are located in Europe.



THE POOL of lubricant and flattened bearings above symbolize some of the research conducted at Battelle Institute, Columbus, Ohio, for the lubricating industry. The four-ball extreme-pressure-lubricant experiment for evaluating high-pressure gear lubricants is started by rotating one bearing, under load, against three others. If the lubricant fails during the one minute rotation period, enough heat is generated to weld the balls together. At severe loads less than the critical load for the lubricant, the approaching failure of the lubricant is indicated by flattened spots on the balls.

BATTELLE INSTITUTE is an independent, scientific research organization that is operated on a not-for-profit basis to furnish research services to industry and government. In the time since 1929, when the Institute started operation with a few dozen persons as a staff and one building in Columbus, Ohio, Battelle has grown consistently until today nearly 2500 technologists and other workers are employed at the Columbus laboratories which now encompass almost one million square feet of floor space. In addition, research laboratories are being operated in Germany and Switzerland and offices are maintained in several other parts of Europe.

The Institute was founded by the will of Gordon Battelle, a pioneer Ohio industrialist, "for the purpose of education . . . encouragement of research . . . and the making of discoveries and inventions of industry." Today the Institute conducts $16 million worth of research annually in many fields. Among them are chemistry, metallurgy, petroleum technology, nucleonics, chemical and electrical engineering, plastics and engineering economics. An investigation may involve the development of a new or improved process, material, machine, or product. It may be aimed to answer a perplexing manufacturing problem or to improve the competitive position of the sponsoring company.

Research or development problems within the fields listed above and many others can be handled by the Institute's staff. Battelle has conducted numerous studies concerned with extreme pressure and bearing lubricants, lubricants and coatings for use in such metal-working operations as extrusion, development of special purpose lubricants, and evaluation of materials for lubricative merit.

Future issues of the NLGI SPOKESMAN will have introductory stories on such new Institute members as American Can Company and Ampol Petroleum (Australia).

Battelle Joins NLGI As a Technical Member

NEW MEMBER

ACHESON EXHIBIT AT FORD MUSEUM

A special exhibit commemorating the centennial of Dr. Edward Acheson was prepared early this year by the staff of the Henry Ford Museum at Dearborn, Michigan. Featured for several months in this special display were facsimiles of Dr. Acheson's more important patents and personal papers, as well as examples of his work in the development of Carborundum, electric-furnace graphite, and colloidal dispersions. The special exhibit originally scheduled for a brief period, has been held over at the Museum since March because of interest shown by visitors.

American Potash Names Murphy Scholarship Winner

American Potash & Chemical Corporation has announced the winner of its $4,000 William J. Murphy Memorial Scholarship as John Charles Roberts III, of Boulder City, Nev.

The college scholarship was set up by the company in memory of William J. Murphy, AP&CC vice-president in charge of Sales, who died last December.

Presentation of the award was made by Robert B. Coons, AP&CC vice-president, Administration, during recent graduation exercises at Boulder City High School.

Young Roberts is the stepson of Thomas L. War, manager, Administrative Services, at the company's Henderson, Nev., electrochemicals plant.

Qualification for the four-year scholarship was open to children of American Potash & Chemical Corporation employees at its various facilities.

Climax Molybdenum Appoints Freeman Manager

Climax Molybdenum Company has announced the appointment of Robert R. Freeman as manager—arc-cast molybdenum development.

Prior to joining Climax, Mr. Freeman had been associated with Westinghouse Electric Corporation in various engineering and supervisory capacities since 1940. During this period

Continued on page 41

HARSHAW LEAD BASE

Harshaw Lead Base, as an additive to petroleum lubricants, improves extreme pressure characteristics and imparts the following desirable properties:

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- Increased lubricity
- Improved wetting of metal surfaces
- A strong bond between lubricant and metal surfaces
- Resistance to welding of metals at high temperatures
- Moisture resistance and inhibits corrosion

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Shell Appoints Grimma Employee Manager

The appointment of G. A. Grimma to the newly created position of manager of employee development for the manufacturing department of Shell Chemical Corporation has been announced by C. W. Humphreys, manufacturing vice president.

In his new position Grimma will hold responsibility for recruiting, developing and placing personnel in manufacturing jobs requiring technical background.

A graduate in organic chemistry from the University of Illinois, he joined Shell Chemical in 1943 in San Francisco as a technologist. Later that same year he was put in charge of one phase of the company's economic evaluation program, and was transferred east in that capacity when Shell moved its headquarters to New York in 1948. In 1950 Grimma was named assistant manager of manufacturing development department, the position he held until his recent appointment.

Grimma, his wife and two sons live at 30 Sprague Road, Scarsdale, New York.

Almost everything that moves either in actual operation or in the process of its making . . . from gate hinges to tractor wheels . . . depends upon grease. That is why lubricants should be bought with care. You can always depend upon Deep Rock highest quality greases and lubricants. They are manufactured to give top lubrication to all moving parts.

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he was engaged in production and in the development of new uses for molybdenum and tungsten. He is the author of a number of technical papers on high temperature applications of molybdenum.

Mr. Freeman has a B.S. degree from Kansas State College and an M. S. degree from Carnegie Institute of Technology.

In his new capacity, he is responsible for the development of new applications for metallic molybdenum and molybdenum-base alloys.

Directors Elected To ACF Industries

The election of Russell C. Taylor and Rudolph Furrer as members of the board of ACF Industries, Incorporated was announced by Charles J. Hardy Jr., chairman of the board.

Mr. Taylor is a vice president, a director and a member of the executive committee of the American Can Company and is also a director of Republic Aviation Corporation.

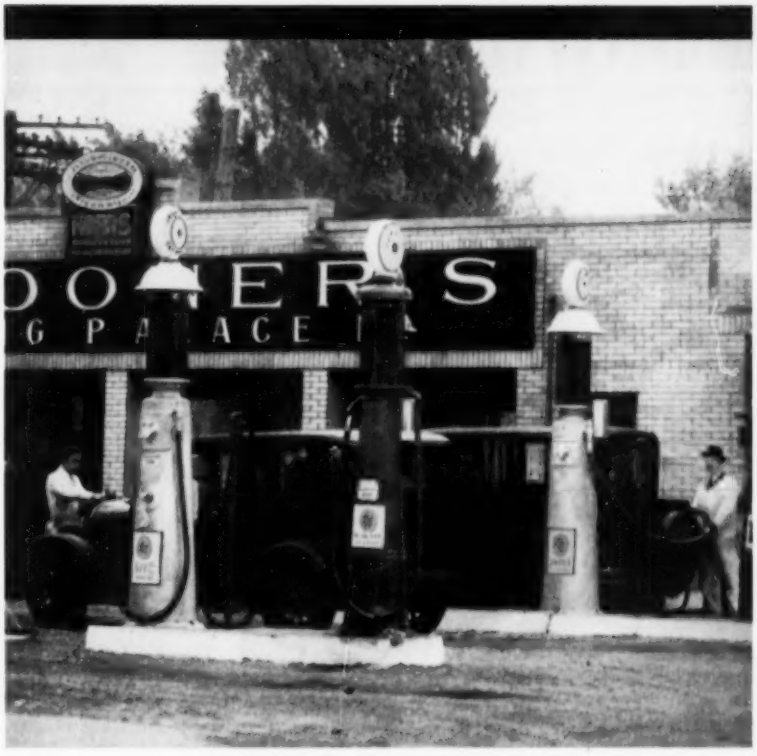
Mr. Furrer is vice president in charge of manufacturing and engineering of ACF Industries and president of the Nuclear Energy Products Division of ACF.

Mr. Taylor has spent his entire business career with American Can Company, starting with the firm in 1926 as a supervisor in its Boston plant. He was graduated from Stevens Institute of Technology with a mechanical engineering degree in 1925 and from Massachusetts Institute of Technology with a master of science degree in 1926. He lives in Greenwich, Conn.

Mr. Furrer, a specialist in industrial automation and ordnance manufacture, served on many advisory committees during World War II and was formerly chairman of the Bomb Committee of the Ordnance Association. In recent years he has served in an advisory capacity on various special and classified projects. He lives in Southport, Conn.

Considine Ordained

The Rev. James L. Considine, Jr. became Vicar of St. Paul's Episcopal Church, Waxahachie, Texas, July 1. He was for eight years employed by Battenfeld Grease and Oil Corp., and three years with Southwest Grease and Oil.



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The problem, of course, was to find an inhibitor—one that in very, very low concentrations would keep light distillates from chewing up metal. It took some searching—but Monsanto chemists came up with Santolene C; just .0015% of it in the stock cut scale formation in a cargo tanker by 2 tons per month.

When you want a base stock modified to meet laboratory specifications before starting expensive field testing . . . send the base stock and your specifications to Monsanto. Monsanto can supply you with Chemical Additives for almost any job an additive can do: Corrosion inhibitors • Detergents • Viscosity index improvers Gear lubricant fortifiers • Fuel oil clarifiers • "Oiliness" improvers.

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Monsanto Chemical Company
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Industry NEWS

Continental Can Acquires Canadian Cork Company

Continental Can Company has announced the acquisition of Canadian Crown Cork Company, Limited. The announcement was made jointly in Montreal by Frank A. Whittall, president of Continental Can Company of Canada Limited and John M. Gardiner, president and general manager of Canadian Crown.

The move marks the first entry of a metal container company in Canada into the crown cork field. Completion of negotiations whereby Continental purchased the capital stock of Canadian Crown through its subsidiary, Colonial Canners Limited, will add crown cork production to existing Continental facilities in metal containers, paper cups and paper milk bottles.

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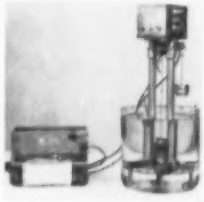
New Instrument Measures Durabilty of Asphalt Pavements



A new instrument that makes possible the first accurate predictions of the life expectancy of asphalts is available for general use, according to Shell Oil Company asphalt engineers.

The instrument, a sliding plate microviscometer, measures the viscosity —resistance to flow—of asphalt under carefully controlled temperatures and shear forces. Its accurate measurements permit selection of asphalts with proper viscosity and great resistance to change—and thus construction of uniformly superior asphalt roads. The microviscometer provides precise answers to questions that paving experts previously had to handle in general terms.

Hallikainen Is Manufacturer

The instrument is being manufactured by Hallikainen Instruments, Berkeley, California. Detailed information and technical data are available from Shell Oil Company.

The key to precision in the test is that measurements are made on an extremely thin film of asphalt—about a hundredth of a millimeter thick. This is the thickness of asphalt that binds stones together in roads and streets.

Test Conditions Improved

Scientists using such samples can run tests under conditions similar to those existing in ordinary pavements. Earlier tests, made on thick layers of asphalt, gave results that had little or no relation to the performance of asphalt as it exists in typical pavements.

To gauge the asphalt's durability, the scientists measure the viscosity of the film, subject it to aging processes, then measure the viscosity again.

The chief advantage of the instrument, according to Shell, is that it provides data never before attainable and hence enables highway construction people to plan roads more efficiently. Results indicating the durability of the sample being tested are expressed in absolute physical units. The instrument was developed by scientists at Shell Development Company, research affiliate of Shell Oil.

To make a test with the microviscometer, a scientist puts a minute quantity of asphalt between two polished glass plates and presses it out to form a thin film. One plate is then moved across the other and the sample is thus sheared. The shearing force and temperature are carefully controlled and recorded.

One of the glass plates is stationary. The other, movable, plate is attached to a wire that is connected to a simple balance beam pivoted on agate bearings and polished steel knife edges. Weights hung on the beam

Continued on page 43

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New Instrument

Continued from page 42

provide the shear force. Temperature is controlled by a water bath.

An electronic circuit is used to follow the movement of the glass plate. This movement may be measured directly by reading the micrometer on the instrument as a function of time. It is also possible to mark the displacement of the glass plate on a millivolt recorder. This provides a graphical record of the test and allow the operator to do other work while the test is in progress.

Large-Scale Research Launched by Gulf

Gulf Research & Development Company reveals that it has undertaken an expanded production research program, to be conducted by 150 scientists, engineers and technicians, in an effort to improve the recovery of petroleum from oil fields.

Specific aims include increasing the percentage of petroleum recovered from oil formations, and bettering both the speed and the economy of drilling wells, producing and transporting oil and gas.

Two new buildings, to cost approximately $1½ million, will house these activities, for which additional staff members are now being recruited. Both will be begun this spring. The smaller, for heavy drilling research, is scheduled for completion in August and the main building in January, 1957.

Four Story Building

The larger structure, of two-tone brick and steel frame, will be four stories high and 227 ft. by 53 ft. in dimensions. It will include some 94 laboratories and offices, besides storage, utility and service rooms.

The latest in chemical laboratory and mechanical equipment will be provided. The building will be completely air-conditioned, fluorescent-lighted and plaster-walled. The building will stand in a tree-lined quadrangle of the 53-acre laboratory grounds.

Underground passages will connect it with the other chief laboratory buildings.

The smaller structure, of concrete block and metal panels, 61 feet by 56 feet in dimensions, will be built around an 80-foot oil well derrick mounted on a 13-foot platform in a 28-foot high bay. Sliding roof panels will permit opening the bay for derrick operation.

There will be a single floor, several offices, and a mud pit for mixing drilling mud. The area beneath the drilling platform is designed for setting up heavy test equipment, such as experimental drills and oil field rock cast in concrete for drilling rate studies.

"The importance of the program in which these facilities will be used," said Dr. Blaine B. Wescott, Gulf Oil Vice President, Research, "is evident from the fact that any progress in upping petroleum recovery will increase the nation's usable oil reserves.

"While it would be foolhardy to think we will ever drain every drop from an oil field, modern research promises to bring us closer to this condition than once considered possible.

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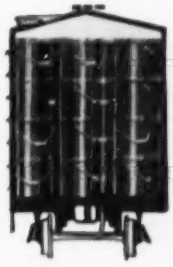

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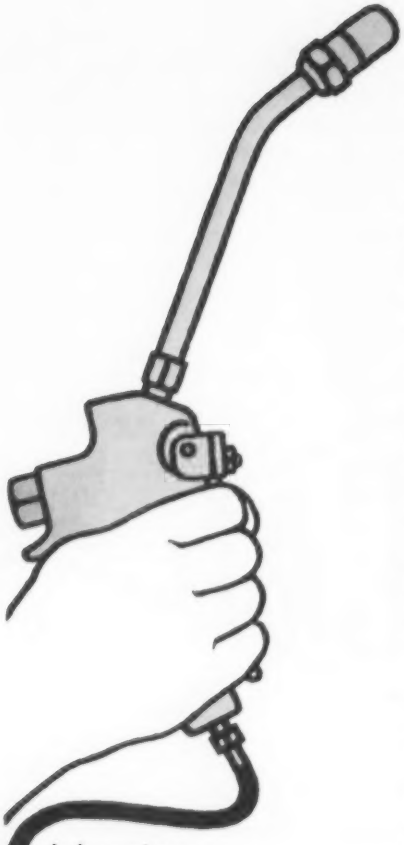

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Penola

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petroleum science toward moving nearer this goal economically is the purpose of the present undertaking."

The staffs which are tackling the assignment include scientists and engineers with degrees in chemistry and physics, and in mechanical, electrical, chemical and petroleum engineering, plus trained technical assistance. Target for achieving full staff strength is 1958.

R. A. Morse, Associate Director of Research, will coordinate the work which will be performed by the Production Engineering and the Reservoir Mechanics Divisions.

Reservoir Mechanics will concentrate on improving the over-all recovery from oil fields. It will study the behavior of oil reservoirs, the flow of oil and other fluids underground, gas and water drives, and thermal recovery methods.

Production Engineering will seek to improve the drilling of wells and the utilization of pipelines. It will study how to increase production through the application of mechanical, hydraulic and chemical methods, and more efficient pumping and fluid handling.

Research on off-shore drilling and production problems will be in its province.

Eliminates "Bugs"

Equipment in the drilling research building will aid this program by eliminating more "bugs" in new equipment and new procedures before field testing. As a result, field test costs will be reduced, and the success average of new developments tried in the field will be advanced.

Production Engineering is directed by E. Topanelian, Jr., formerly director of the Engineering Division, with A. J. Teplitz, formerly Assistant Director in the Materials and Production Chemistry Division, as Assistant Director.

Dr. M. R. J. Wyllie, who held the previous post of Assistant Director, Geology and Geochemistry Division, heads the Reservoir Mechanics Division.

The program as a whole represents an effort to place the problem of better, more economical oil recovery under concentrated, sustained attack by application of the best scientific skills and equipment.

API Announces Film Series About Oil

A series of TV film shorts that combine popular appeal and unique facts about oil soon will be made available to television stations throughout the country.

This has been announced by H. B. Miller, Executive Director of the Oil Industry Information Committee of the American Petroleum Institute, who added that the films have been prepared specifically for television showings.

"Progress Parade" is Title

Titled "Progress Parade," the films are designed to be used by local TV stations on sustaining time. Each film, of which there are to be four per year, will be 13¼ minutes in length, and will be in black and white.

Miller said the films will be made available to TV stations on a "permanent loan" basis, and will be distributed through OIIC district offices.

Emphasizing the high caliber of the series, Miller said that a pilot film was tested by 100 TV stations, and that not only was initial response favorable, but the stations also said they wanted to use it and subsequent issues on a regular basis.

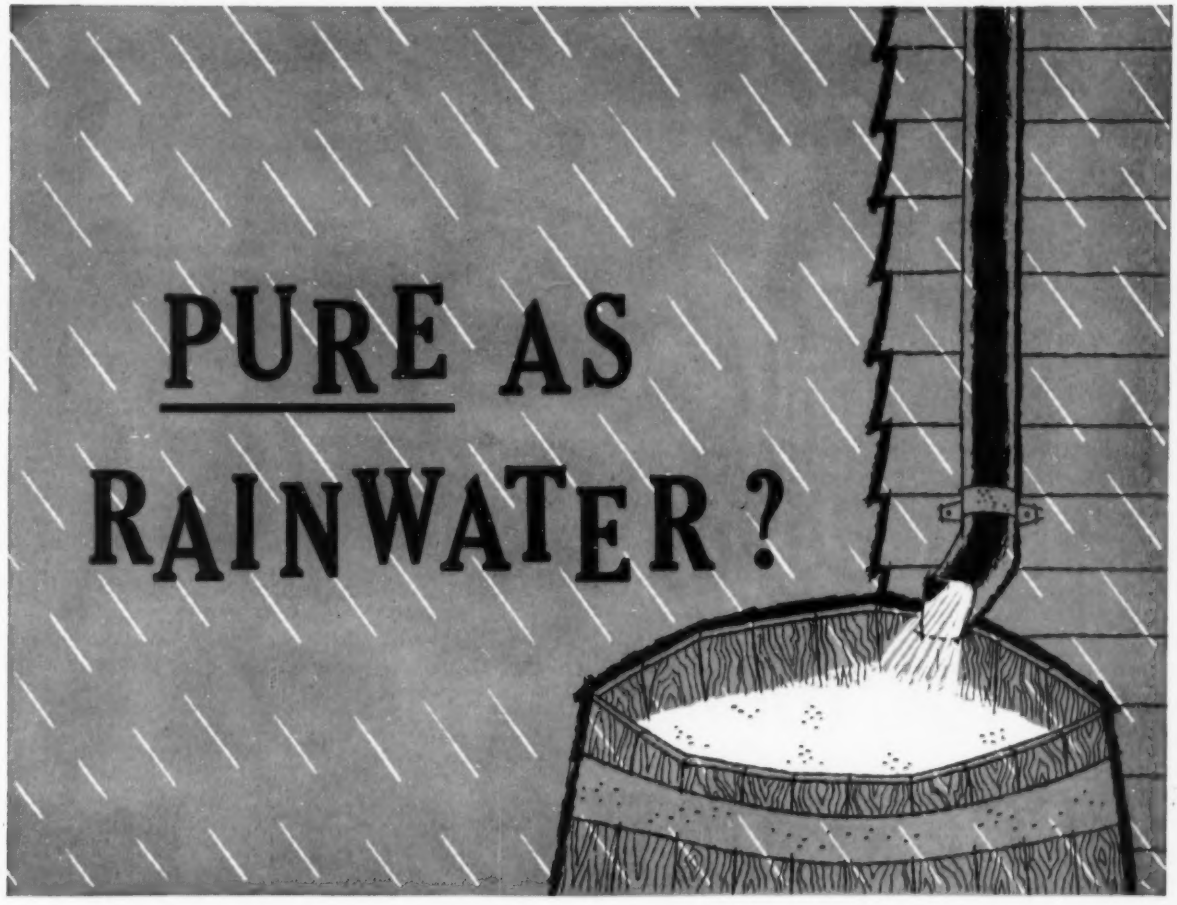
The first edition of "Progress Parade" was released early in July, and a second will follow in October. Thereafter, it is anticipated that the films will be produced on a quarterly basis.

The OIIC Executive Director said that in addition to the exceptionally high acceptance of "Progress Parade" by TV stations, "we received a great many complimentary comments on the quality of the program." Specifically noted, he continued, "were the interesting subjects chosen, their effective presentation, film production values, and the print and sound quality."

Format of Short Episodes

The format for "Progress Parade" consists of short episodes and stories related to oil. These stories are chosen for their public interest, newsworthiness, and audience appeal. Although they are documentary in nature, the short-term production schedule will permit inclusion of timely reports on particular problems facing the oil industry, Miller said.

Continued on page 47



In olden days before smog was invented, perhaps rain actually was pure enough to merit this saying.

But today *"pure as a Metasap Stearate"* would far more accurately describe perfect purity—that helps you make specialty greases 6-ways better with sure, dependable performance.

For the varied Metasap Stearates produce greases that are smoother in texture, more economical—and moisture-proof, temperature-resistant and water-repellant too! They do a better job... under toughest conditions anywhere in the world!

Whatever your grease requirements, call on Metasap. For free samples, comprehensive information and advice from our technical staff, please write.

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These Metasap grease bases are all truly uniform—and economical too!

METASAP 598. High gel type for use where high yields are most important.

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METAVIS 540. Can be used with wide range of mineral oils; produces semifluid, adhesive-type lubricant known as castor machine oil. Highly economical.

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Get Ready for Your BIGGEST DATE!

It's coming soon! Your biggest and possibly most important date in 1956—OIL PROGRESS WEEK! It's your chance to make friends for yourself—and your industry.

Each year one week is set aside to bring the oil industry's story directly to the American public. And today more than ever the American people need to know more about your industry—and this is your chance to tell them. Remember, those who know you best like you best.

HERE'S WHAT YOU CAN DO

Contact your supervisor, company coordinator, or the editor of this publication. He will tell you how you can participate in Oil Progress Week activities. Participation will be good for you and for your industry.

October 14th is nearer than you think and, as you know, it takes time to contact people and organize activities. Find out today how you can participate in

OIL PROGRESS WEEK
October 14-20

Each issue will cover from three to five subjects. The first issue covered five topics, as follows: "Fishing on Dry Land," "Baby Demands Comfort," "Wearing Two Hats," "Bottle of Magic," and "Lifeline to an Oyster." The last-named, for example, tells how the oil industry invested two million dollars in a research program to find out what was killing the oysters in the Gulf of Mexico. Their objective, admittedly, was a selfish one, since the oil industry had been accused of destroying the oyster beds. The research proved otherwise, and the knowledge obtained was given to the oyster industry on a "good neighbor" basis.

API Plans School of Pipe Line Technology

Preliminary plans for a School of Pipe Line Technology have been announced by the Division of Transportation of the American Petroleum Institute.

Its objective is to help insure the availability of qualified manpower to staff an industry which, in the next decade, is expected to witness far-reaching expansion.

The school will be operated by the Petroleum Extension Service of the University of Texas, in cooperation with Lee College, Baytown, Tex., and the Trade and Industrial Service of Texas Education Agency. It will be sponsored by the Institute's Transportation Division.

Present plans call for the school to open its fall term around October 1, and its Spring term in February. Each term will be complete in itself, and will run six weeks.

Enrollment will be limited to 30 persons, and the fee will be $300. Instructions will be given by outstanding specialists from the industry and universities. Lectures, demonstrations, motion pictures, exhibits, and field trips will be combined to make the course as effective as possible.

Sessions Held at Lee College

All sessions will be held on the campus of Lee College, which is about 25 miles east of Houston. In the area is to be found one of the greatest concentrations of petroleum pipe line operations in the world. Within 50 miles of Baytown are oil fields, gas fields, gathering systems, main line stations and terminals, refineries, products lines, and marine loading facilities.

Topics to be covered in the six-week course include the economics and history of pipe line transportation, personnel organization, industrial and public relations, main line design and construction, main line maintenance, main line corrosion control, gathering systems design and construc-

Technical Committee

Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Mobil Laboratories

The membership of the committee who will organize and conduct the 1956 panel discussion in "Lubrication of Ball Bearings" is the following:

Dr. H. L. Leland, Chairman
Esso Research & Engineering Company
Products Research Division
P.O. Box 51
Linden, New Jersey

Mr. H. Apkarian
General Electric Company
Schenectady, New York

Mr. M. L. Carter
Southwest Grease & Oil Company, Inc.
220 West Waterman Street
Wichita, Kansas

Mr. C. H. Gillette
General Motors Corporation
Bristol, Connecticut

Mr. R. F. Repenning
Shell Oil Company
50 West 50th Street
New York, New York

Mr. T. G. Roehner, ex officio
Socony Mobil Oil Company, Inc.
412 Greenpoint Avenue
Brooklyn 22, New York

Mr. L. C. Rotter
Lincoln Engineering Company
5701 Natural Bridge Avenue
St. Louis 20, Missouri

It will be recalled that this panel discussion will be included in the agenda for the first two days of the NLGI Annual Meeting, October 22-24, 1956, in Chicago, Illinois. There is still time for members to submit suggestions to any member of the above mentioned committee regarding procurement of authoritative kick-off speakers and for organization of the question and answer period.

Relative to the symposium to be held as part of the annual Technical Committee Meeting, steps have been taken to obtain two or more short lead-off papers to supplement that being prepared by G. W. Eckert of The Texas Company research center on factors determining the extent of changes of consistency of lubricating greases during storage in containers. Members are urged to send suggestions regarding organization of this symposium to L. C. Brunstrum, E. W. Nelson or T. G. Roehner.

NLGI's 24th ANNUAL MEETING—OCTOBER 22-24

tion, gathering systems operation and maintenance, main line tank farms, terminals, main line stations design and construction, main line stations operation and maintenance, scheduling and dispatching, communications, and reclaiming and salvage.

The API announcement said the school is planned primarily for pipe line supervisors and prospective supervisors. It emphasized: "In brief, the sponsors propose to establish a resident training center in the heart of the Gulf Coast petroleum shipping and processing area; to offer here a tightly-organized curriculum of six weeks of practical education on pipe line transportation; and to bring to the enrollees, as instructors, outstanding specialists from companies and from universities of the area."

Kerr-McGee Opens Denver Office

A new Denver office combining mining and ore processing headquarters and a metallurgical research laboratory has been opened by Kerr-McGee Oil Industries, Inc.

McGEAN 30% LEAD NAPHTHENATE ADDITIVE

Consistently uniform in metallic content and viscosity

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Continental Can and Cochran Announce New Company

The formation of a new company, Cochran Continental Container Corporation, was announced jointly by General Lucius D. Clay, chairman of the board of Continental Can Company and Archie P. Cochran, president of Cochran Foil Company, Louisville, Kentucky.

The new company, owned equally by Cochran and Continental, will combine the facilities and organization of the Cochran Products Division, one of the original and largest manufacturers of aluminum rigid foil containers, and those of Continental, a leader in the development of materials, processes and machines for the packaging industry. No other operations of Cochran Foil are involved.

Cochran Continental headquarters and principal plant facilities will be located in Louisville, Kentucky. Here the expanded facilities will permit the manufacture and national distribution of aluminum TV dinner plates, pie plates and the many new rigid foil convenience packages being used extensively in the frozen food, bakery, dairy and other industries.

Heading the office and laboratory, located at 4931 East 38th Avenue in Denver, is V. L. Mattson, Kerr-McGee's manager of mining and uranium ore processing. Mattson's offices formerly were located in the Farmers Union building.

All metallurgical research conducted by the company, as well as process research connected with Kermac's Navajo Uranium division mill operation at Shiprock, N.M., will be conducted in the laboratory.

Mayer Goren, formerly assigned to the company's research laboratory in Oklahoma City, has been transferred to the new installation at Denver. Kerr-McGee has closed its lab at Boulder, Colorado, and Wayne Hazen and A. V. Henrickson have been moved from Boulder to Denver. Edgar B. Anderson, formerly with Climax Molybdenum Company, joined the laboratory as analyst June 18. Other member of the staff is secretary Jane Spence.

Officials said the company is still in the process of strengthening the staff of the laboratory. Equipment includes a spectrophotometer with recorder and other instruments used in analysis, as well as materials for limited pilot plant operation.

Kerr-McGee's petroleum products and processing research program will continue in the laboratory at 36th and Santa Fe Avenue, Oklahoma City.

Climax Jointly Establishes Offshore Oilwells

Organization of Deepwater Exploration Company, established for contract drilling of offshore oil wells, has been announced by B. V. Bock, of Wichita, Kansas, who will serve as president and chief executive.

The new company, with initial headquarters at 1315 Gravier Street, New Orleans, is jointly owned by Climax Molybdenum Company, of New York, N. Y., Anderson-Prichard Oil Corporation, of Oklahoma City, Oklahoma, Mr. Bock and J. H. Hester. Mr. Hester will serve as vice president and general manager of drilling operations. J. Taylor, formerly assistant manager of Gulf Coast drilling for the Superior Oil Company, will supervise the Deepwater Tender. R. J. Loeffler, formerly with Creole Petroleum Corporation, will serve as exploration manager.

Mr. Bock announced that the company has acquired an ex-Lst which had previously been in coastal service. It is being converted to a non-propelled drilling tender at the Jacksonville, Florida, yard of the Gibbs Corporation according to plans and specifications of the naval architect firm of Friede and Goldman. The tender is 327' 9" in length, 50' beam and draws 12'.

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FUTURE MEETINGS of the Industry

AUGUST, 1956

16 API OIIC Steering Committee, API Board Room, New York City

19-24 National Congress of Petroleum Retailers, Inc. (10th annual session), Shoreham Hotel, Washington, D. C.

SEPTEMBER, 1956

6-7 API Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.

7 Midwest Research Institute Symposium on Industrial Development, Linda Hall Library, Kansas City, Mo.

7-8 Desk & Derrick Club, New Orleans, La.

12-14 National Petroleum Association (annual meeting), Traymore Hotel, Atlantic City, N. J.

13-14 Petroleum Packaging Committee, Palmer House, Chicago, Illinois.

16-18 New Mexico Petroleum Industries Committee (annual convention), Hilton Hotel, Albuquerque.

16-21 American Chemical Society (130th annual meeting), Atlantic City, N. J.

16-22 ASTM 2nd Pacific Area National Meeting and Apparatus Exhibit, Hotel Statler, Los Angeles, Calif.

18-19 Ohio Petroleum Marketers Association, Fall Conference and Golf Tournament. Sheraton-Mayflower Hotel and Fairlawn Country Club, Akron, Ohio.

19-21 National Industrial Conference Board (marketing meeting) Waldorf-Astoria Hotel, New York, N. Y.

20-21 Western Petroleum Refiners Association (technical industrial relations meeting), Henning Hotel, Casper, Wyo.

20-21 Mid-Continent Oil & Gas Assn. (membership meeting La.-Ark. Division), Roosevelt Hotel, New Orleans, La.

24-25 IOCA Ninth Annual Meeting, Bismarck Hotel, Chicago, Ill.

OCTOBER, 1956

1-3 Texas Mid-Continent Oil & Gas Association (annual meeting), Rice Hotel, Houston, Texas.

2-3 Texas Mid-Continent Oil and Gas Association (37th annual meeting), Rice Hotel, Houston.

2-4 National Association of Corrosion Engineers (South central region), Beaumont, Texas.

2-6 Society of Automotive Engineers, Inc. (national aeronautic meeting, aircraft engrg. display), Statler Hotel, Los Angeles.

3 American Iron and Steel Institute (regional technical meeting), Thomas Jefferson Hotel, Birmingham.

1-5 American Institute of Electrical Engrs. (1956 Fall general), Morrison Hotel, Chicago, Ill.

7-9 American Association of Oilwell Drilling Contractors (annual meeting), Texas Hotel, Fort Worth.

8-10 The American Society of Mechanical Engineers (joint ASME-ASLE lubrication conference), Chalfonte - Haddon Hall, Atlantic City.

11-12 California Natural Gasoline Association (fall meeting), Sheraton Hintington Hotel, Pasadena, Cal.

14-20 American Petroleum Institute Oil Progress Week.

15-17 American Institute of Mining, Metallurgical, and Petroleum Engineers, Petroleum Branch, Biltmore Hotel, Los Angeles.

15-19 American Society of Civil Engineers (annual convention), William Penn Hotel, Pittsburgh, Pa.

17-19 National Industrial Conference Board (atomic energy meeting), Waldorf-Astoria Hotel, New York, N. Y.

18-19 Western Petroleum Refiners Association (technical industrial relations meeting), Rufus Garrett Hotel, El Dorado, Ark.

22-24 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

22-24 American Standards Association (7th national conference on standards), Roosevelt Hotel, New York City.

22-24 Rocky Mountain Oil and Gas Association (annual convention), Cosmopolitan Hotel, Denver.

23 American Society of Safety Engineers (annual meeting), Conrad Hilton Hotel, Chicago.

29-30 Independent Petroleum Association of America (annual meeting) Statler Hotel, Dallas, Texas.

NOVEMBER, 1956

1-2 SAE National Diesel Engine Meeting, Drake Hotel, Chicago.

8-9 SAE National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

8-10 National Oil Jobbers Council (annual meeting), Palmer House, Chicago.

12 API OIIC Steering Committee, Conrad Hilton Hotel, Chicago.

12-15 American Petroleum Institute (36th annual meeting), Conrad Hilton & Palmer House, Chicago, Ill.

26-30 National Exposition of Power and Mechanical Engineering (ASME), New Coliseum, New York, N. Y.

27-30 American Chemical Society (9th National Chemical Exposition), Cleveland, Ohio.

DECEMBER, 1956

4-5 Petroleum Packaging Committee, Savannah, Georgia..

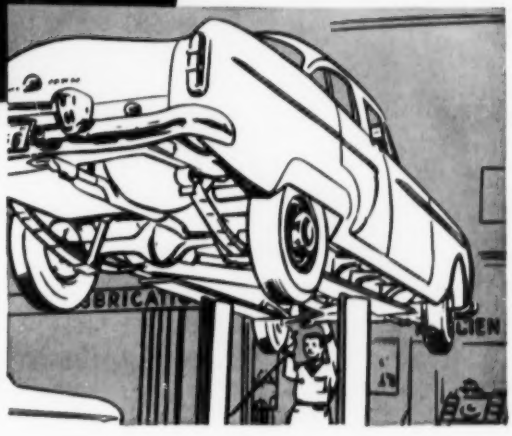
APRIL, 1957

16-18 National Petroleum Association, Cleveland, Ohio.

JUNE, 1957

16-21 American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

from Coal Mining Equipment to Automobiles...



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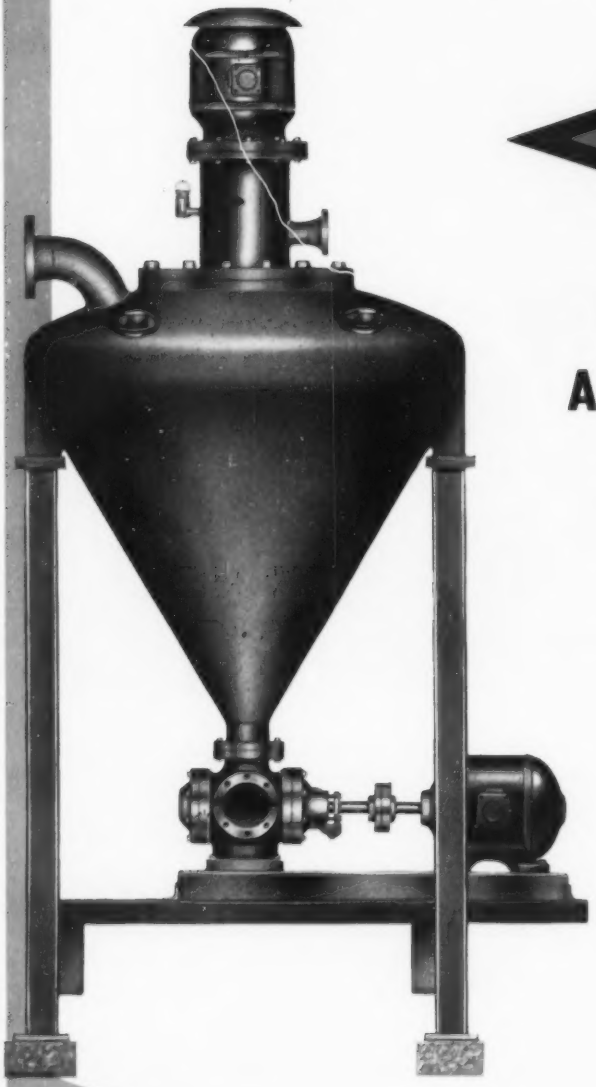

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